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New Ranking Algorithm

Quantum Computing Tutorial

Highlights

A Round-Robin Tournament

Bits vs Qubits & Shor's Algorithm

Discovering Thoughts, Inventing Future

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A Convergence of Information Technology and Psychology: A Behavioral Study

By Jeffrey S. Linney
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Abstract- Face-to-Face (FTF) communication is a high social presence communications technology meaning that the sender's intended message is not likely to be ignored by the receiver. In comparison, text-messaging is a low social presence communications technology where the sender's message has a higher tendency to be ignored by the receiver. Text-messaging is by far the most popular communications technology among a sizable percentage of the college population. The act of help-seeking is a behavior that arises out of a human psychological attitude or process that has been studied extensively by psychologists and educational scholars. This study sought to investigate the behavioral intention (BI) of college students to use short messaging service (SMS) text-messaging to complete the behavioral task of academic help-seeking (AHS). The entire student body at a small, private junior college in eastern North Carolina were surveyed. The findings revealing that although text-messaging was extremely popular across all student groups, it did not fare as well as expected as a potential AHS tool.

Keywords: text-messaging; short message service (SMS); information systems (IS); information technology (IT); academic help-seeking (AHS).

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A Convergence of Information Technology and Psychology: A Behavioral Study

Jeffrey S. Linney

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Keywords: text-messaging; short message service (SMS); information systems (IS); information technology (IT); academic help-seeking (AHS).

I. Introduction

Help-seeking research was conducted fairly extensively by psychology researchers at the start of the 1980's. DePaulo contributed greatly to the body of knowledge in the area of help-seeking during this period (DePaulo & Fisher, 1980; DePaulo & Fisher, 1981; DePaulo, Dull, Greenberg, & Swain, 1989).

According to DePaulo and Fisher (1980), the consideration of two different types of psychological cost creates a state of constant conflict among potential help-seekers. To explain, a help-seeker will weigh the risk of perceived incompetence against the need to seek help for matters that he or she should already be able to competently handle or address. In addition, the help-seeker will also weigh the perceived inconvenience experienced by the person providing this help against his or her individual need for assistance.

In essence, DePaulo and Fisher (1980) suggested that if a potential help-seeker would risk embarrassment due to a perceived incompetence by asking for help, he or she would feel less comfortable about seeking help. As this study attempts to bridge the two worlds of Psychology and Technology, one particular communications technology that warrants further research is short message service (SMS) text-messaging. SMS text-messaging is an extremely popular low social presence communications technology among American college students (Quan-Haase, 2008). Text-messaging allows users to communicate in an on-screen, text-based format utilizing combinations of alphanumerical characters (Soriano, Raikundalia, & Szajman, 2005). Soriano et al. (2005) iterated that text-messaging offers a means for increased social interaction in addition to an accurate, efficient, and distinct means of communication. Perry, O'Hara, Sellen, Brown, and Harper (2001) acknowledged that research on mobile communications media, such as text-messaging, has emerged as an important field of study within itself.

II. Related Work

The essence of AHS, as interpreted from definitions in the scholarly literature, suggests that AHS is a set of skills that involves asking for assistance and advice from available help sources (Fallon & Bowles, 1999; Gould, Udry, Bridges, & Beck, 1997).

One important justification for the current problem first stems from the fact that scientific study is currently lacking that could possibly reveal how text-messaging can benefit college students in completing the task of AHS (Kitsantas & Chow, 2007). Second, it should be noted that research involving text-messaging is still relatively new (Soriano, Raikundalia, & Szajman, 2005) which could explain why few if any studies have been done to address its potential as a useful mobile communications method for the completion of interpersonal tasks. The primary goal of this study was to investigate college students' behavioral intention (BI) to use text-messaging to complete the interpersonal task of academic help-seeking (AHS). The contribution that this study makes to the scholarly community is a more in-depth understanding of text-messaging and its usefulness for completing interpersonal tasks in the absence of verbal cues typically present and desirable in human communication. Three research questions were investigated to achieve the primary research goal.

RQ1: How does the availability of text-messaging technology impact intention toward completing interpersonal tasks among college students?

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The first research question sought to measure behavioral intention (BI) to use text-messaging among college students to complete tasks in an AHS context.

RQ2: How was text-messaging technology viewed as a medium for interpersonal task completion, specifically with regard to AHS?

The second research question sought to reveal how the college students' actually felt, and the opinions they formed upon the potential selection of text-messaging and its usefulness towards completing AHS tasks. It is argued that despite its immense popularity, no studies have been found in the scholarly literature to date that have explored text-messaging exclusively for college students as a means for completing the task of AHS. Additionally, previous BI to use IS studies have focused on media selection and choice regarding a variety of communications media, but no studies were found to date that included text-messaging as an option.

RQ3: What are the characteristics of college students who prefer text-messaging technology to complete the task of AHS?.

The third research question sought to identify the characteristics of users who may actually utilize text-messaging for engaging in AHS. The third research question is important as user attitudes, gender, experience with the technology, and competency, expressed as user characteristics, are useful in the human-technology matching component of media selection.

III. Research Methods

This study employed a descriptive approach to assess behavioral intention to use text-messaging for the interpersonal task of AHS among college students. The interpersonal task of AHS was assessed with the aid of a variety of AHS vignettes. This study was conceived based upon previous research reviewed in the scholarly information systems (IS) literature (Hoar and Flint, 2008, Kitsantas and Chow, 2007, Markett, Sánchez, Weber, & Tangney, 2006).

As part of an overview session, the participants were asked to complete an open-ended questionnaire where they answered a series of questions pertaining to their individual opinions with regard to text-messaging. The open-ended questions were analyzed using the process of content analysis to seek any common themes that were tallied to reveal the respondents viewpoints and preferences with regard to text-messaging.

The participants then viewed a series of vignettes depicting hypothetical scenarios that ultimately suggested the need for some type of AHS assistance. Based on the information contained in the vignettes, the participants were then asked to indicate whether text-messaging would be a viable option for that particular scenario and to provide a brief rationale for their answers. A 6-point Likert-scale survey instrument was administered to measure computer user self-efficacy (CUSE) as it influences behavioral intention (BI) to use. Additionally, an ordinal scale instrument was administered to capture the participant's experience using technology (EUT), in this instance, text-messaging. The participants concluded by completing a survey instrument recording demographic data.

a) Descriptive Approach

This study involved descriptive research. Utilizing the survey method, the participants were administered surveys, questionnaires, and open-ended questions in order for the principal researcher to answer the three research questions posed. The observations (data) that were collected were then described in both textual and graphical form. What this study did not attempt to do was draw relationship-based conclusions from the data that was received. Qualitative and quantitative research methods were employed to report the findings.

Qualitative research deals almost exclusively with meanings, expressed either verbally or in writing, while quantitative research deals specifically with numerical distributions and frequencies when collecting and analyzing the data (Spratt, Walker, & Robinson, 2004). The quantitative aspect of this study consisted of a 6-point Likert-scale survey instrument that was utilized to collect data pertaining to the participants' stated comfort and skill levels with regard to text-messaging. The 6-point Likert-scale consisted of a range from (1) "Disagree" to (6) "Agree". The qualitative aspect of this study consisted of an open-ended questionnaire where the participants stated, in their own words, their likes and dislikes and frequency of use with regard to text-messaging that was the focus of this study. Consequently, the written statements from the participants assisted in explaining several items of interest such as if they would in fact utilize text-messaging for AHS, and a content analysis revealed why text-messaging was found to be effective for AHS, or not. Utilizing descriptive research methods, this study sought to meet the research goal to examine BI to use SMS text-messaging to allow college students to engage in a specific interpersonal task. The following sections of this paper will describe in detail how each of the research questions for this study was answered.

Research Question One

RQ1 addressed: How does the availability of text-messaging technology impact intention toward completing interpersonal tasks among college students?

Instrument Selection

An open-ended questionnaire was administered as part of an overview session after the participants read

descriptive passages regarding the features and capabilities of SMS text-messaging. Forman (2009) utilized an open-ended questionnaire to elicit additional responses from the participants with regard to the construct of perceived consequences. This study used a slightly modified version of Foreman's instrument to allow the participants to state their individual likes and dislikes with regard to text-messaging. This data was analyzed and categorized for a detailed qualitative summary of the findings. The open-ended questionnaire also revealed how the participants may or may not elect to use text-messaging for AHS completion.

b) Data Analysis and Statistical Measures

The participants initially completed an open-ended questionnaire allowing them to state one advantage or like and one disadvantage or dislike with regard to text-messaging. Utilizing descriptive statistics, the responses were tallied and averaged, expressed as total percentages. The responses from the open-ended questionnaire were also calculated as total percentages and displayed as frequency counts in a distribution table. Part one of a validated survey instrument from Cassidy and Eachus (2002) assisted in measuring CUSE toward text-messaging for completing the task of AHS. This instrument asked the respondents to indicate the strength of their agreement or disagreement with select statements using a numerical rating scale between 1 and 6 that most closely represented how much they agreed or disagreed with each statement. The lower their number, the more they disagreed with the statement. The higher their number, the more they agreed with the statement. Frequency distribution tables were created with data from the 6-point Likert-scale to reveal the distribution and compare how they were viewed by the respondents as a means to complete the interpersonal task of AHS.

Research Question Two

RQ2 addressed: Out of the available selection of communications media, how was text-messaging technology viewed as a medium for interpersonal task completion, specifically with regard to AHS?

Instrument Selection

Vignettes were adopted from Spendelow and Jose (2010), Altschuller and Benbunan-Fich (2009), Gattiker and Kelley (1999), and Hoar and Flint (2008) to aid in revealing the participants BI to use text-messaging for AHS. The vignettes and questionnaire that were utilized were subjected to a validation process for this study. The nominal group technique (NGT) was implemented for this purpose. According to Abdullah and Islam (2011), the NGT is designed to generate a large number of ideas related to an issue resulting in brainstorming and the equal presentation of ideas from within a structured group, while also preventing one single person from dominating the discussion.

Furthermore, the NGT is a useful tool in problem identification and its small group approach promotes shared solutions and the ranking of ideas (van der Waal & Uys, 2009). Vignettes were utilized to provide the contextual hypothetical scenarios that allowed the participants to state their BI to use text-messaging in order to seek academic help (AH). Vignettes are popular clinical assessment methods that have led to many important findings in help-seeking research (Spendelow & Jose, 2010). One type of vignette is referred to as an anchoring vignette that contains a short description of a hypothetical situation measuring a single concept (King, Murray, Salomon, & Tandon, (2004). According to Spende low and Jose (2010), vignettes can be written in second person reflecting the self or third person looking at a situation through the experience of another. The anchoring vignette approach was adopted for this study to provide AHS scenarios that the study participants reflected upon in an AHS context. A series of open-ended follow-up questions were devised that aligned with each vignette, thus providing the participants with the opportunity to indicate their intention to use text-messaging in each of three AHS scenarios. The open-ended questions were developed based upon the previous work of Foreman (2009) who used a similar instrument in her investigation of perceived consequences with digital piracy.

c) Data Analysis and Statistical Measures

The data analyzed and measured to answer RQ2 were collected with two data collection instruments. The first was an instrument containing a series of AHS vignettes. The vignettes were developed depicting subjects in a situation that would prompt the need for AH. Written in second person narrative, the reader placed him or herself into the AHS scenario. Accompanying the vignettes was a series of corresponding questions that dictated brief written responses from the participants allowing them to state whether or not they would utilize text-messaging in that particular situation and also include their rationale to justify their decision.

Research Question Three

RQ3 addressed: What are the characteristics of college students who prefer text-messaging technology to complete the task of AHS?

Instrument Selection

This study captured and measured characteristics of the participants to include experience using technology (EUT), computer user self-efficacy (CUSE) and demographic data. CUSE was measured with a validated forced-choice instrument by Cassidy and Eachus (2002) measuring CUSE and EUT. Demographic data of gender, race, and class rank were collected using a slightly modified version of an instrument validated and utilized by Wynn (2009) who

examined BI relating to the online shopping experience. However, categories from that instrument pertaining to age, salary range, employment status, marital status, and level of education were omitted in the modified instrument to be used in this study.

d) Data Analysis and Statistical Measures

A demographics survey instrument required the study participants to submit information using forced choice responses. For example, Gender (1 = male, 2 = female), Race (1 = White, 2 = African American, 3 = Hispanic/Latino, 4 = Asian, 5 = Native American, 6 = Other/Mixed Race), and Class (1 = Freshman, 2 = Sophomore). Categories pertaining to class and membership in special student populations were substituted for omitted categories deemed inapplicable to the current study. The demographic data was used to categorize college students who may consider text-messaging to be useful for completing interpersonal tasks such as AHS. A content analysis was conducted where the data was cross-tabulated by gender, class rank, special population, race and ethnicity compared with CUSE and EUT. The responses from the demographics instrument were displayed as frequency counts and percentages displayed in distribution tables. The data collected from the instrument by Cassidy and Eachus (2002) to measure EUT and CUSE was analyzed to reveal the following information:

- A description of the participants' actual hands-on experiences with text-messaging.
- A description of the participants' perceived skill and comfort in the use of text-messaging.
- A cross-sectional view of the participants' actual hands-on experiences and perceived skill and comfort in the use of text-messaging.

Males were compared with females to measure the AHS equivalencies between both genders and the results were displayed graphically in a series of frequency tables. The same comparisons were made between freshmen and sophomores, as well as students in special populations. The ordinal data from the Cassidy and Eachus instrument measuring EUT and CUSE along with the data collected from the forced-choice demographics instrument collectively represent the user characteristics of college students to assist in answering RQ3.

e) Population and Sample

The sample was derived from the college student population at a small residential junior college in Northeastern North Carolina with a total enrollment of approximately 600 students. Approximately 43% of the study population is comprised of athletes (C.B. Sloan, personal communication, January 03, 2012). The entire population was sampled in an attempt to reach the highest validity possible. However, the minimum sample size required from a population of 600 is 248 participants based on a 95% confidence level with a margin of error of 5%. At the conclusion of the data collection period over the course of approximately six months, a total of 313 students had completed the survey with 259 completing the survey in its entirety without skipping any questions. A total of 54 incomplete surveys were omitted from the study altogether.

f) Validity and Reliability

Vignettes were developed in this study to answer RQ2 that was subjected to an expert NGT panel to undergo the process of establishing validity and reliability. The process of reliability is meant to evaluate a measure for its accuracy. Validity ensures that the process, technique or instrument that aided in measuring an intended concept does in fact measure that intended concept (Sekaran, 2003). Additionally, Sekaran offered that external validity indicates the generalize ability of the results of a study to other people, settings, or events. This generalize ability within a study increases upon using relevant variables examined in previous research and then upon excluding any non-relevant variables (Hair, Anderson, Tatham, & Black, 1998).

g) Pre-Analysis Data Cleaning

Pre-analysis data cleaning involves detecting any irregularities in order to preserve accuracy during the data analysis phase. Data needs to be cleaned prior to analysis to detect and cope with response-set, missing data, outliers or extreme cases, and preserving the accuracy of the data (Levy, 2006). According to Hair et al. (2006), response-set occurs when there is a "series of systematic responses by a participant that reflects a bias or consistent pattern" (p. 558).

There was a series of steps that were taken to complete the pre-analysis data cleaning stage of this study. Beginning with the accuracy of the date, the fact that the participants in this study had limited responses to choose from upon answering the survey questions should have resulted in either eliminating or reducing the possibility of invalid responses impacting accuracy of the data. However, there were some responses found to be inapplicable and unusable from the respondents when answering some of the questions within the survey instruments. For example, the abbreviation "idk" (I don't know) appeared numerous times by some of the respondents. "No" or "none" appeared at inappropriate times in the responses for some of the questions, as well as what appeared to be other unrecognizable abbreviations instead of an appropriate response. These unusable responses were separately tallied and reported as uncategorized responses.

Response-sets occur when the participants' responses may not reflect their true intentions, beliefs, opinions, or when the participants only use a portion of the rating scale. Kerlinger and Lee (2000) suggested analyzing the data for possible response-sets and to

consider eliminating them from the study. Upon instances of what was deemed to be valid issues of response-set, the suspect questions were invalidated and disqualified in the data analysis phase. Mertler and Vannatta (2005) also suggested that missing data, or incomplete surveys, should be addressed in similar fashion. Skipped responses were noted in the findings within the distribution tables.

IV. Results

Results for Research Question 1: How does the availability of text-messaging impact intention toward completing AHS tasks among college students?

With regard to RQ1, themes derived from a content analysis of the questionnaires revealed, as far as the most "advantages", 45% (n = 117) considered text-messaging to be "fast" and another 16% (n = 43) considered it to be "easy". Other themes identified from the findings indicated that 16% (n=43) considered it a favorable alternative to actually talking on the telephone, % (n=37) indicated its likability due to the fact that it fosters a sense of privacy, and 08x% (n=22) admired and respected text-messaging for the simple reason that it is not a communication media meant for formal communication. Since text-messaging is a cell phone technology, the respondents also included cell phone traits in the content analysis. As far as disadvantages, the content analysis revealed that the largest disadvantage listed was "no service/signal" (n = 91) or 35%, "wait time" (n = 62) or 24%, "misinterpretations" (n = 56) or 21%, and "impersonal" (n = 27) or 10%. Uncategorized responses totaled n = 23 or 8% of the disadvantages of using text messaging as a behavioral intention toward completing the interpersonal task of AHS.

To better assess text-message usage and to what extent college students use it to complete interpersonal tasks such as AHS, the survey asked respondents to indicate the strength of their agreement or disagreement with select statements using a rating scale with numbers between 1 and 6 that most closely represented how much they agree or disagree with a statement. The lower their number, the more they disagreed with the statement. The higher their number, the more they agreed with the statement. All responses are reported in Table 1.

Table 1: Computer User Self-Efficiency Responses

Question	Disagree (1)	(2)	(3)	(4)	(5)	Agree (6)	Rating Average	Response Count
1. At times I find working with text-messaging very confusing (Q1)	189	27	14	17	9	5	1.64	261
2. Text-messages are good learning aids (Q2)	29	46	44	54	33	55	3.69	261
3. Sometimes, when using text-messaging, things seem to happen and I don't know why (Q3)	99	45	31	42	18	26	2.67	261
4. Text-messaging helps me to save a lot of time (Q4)	8	10	22	36	36	149	5.03	261
5. I find working with text-messaging very frustrating (Q5)	170	32	19	21	7	12	1.85	261

In Table 1, a rating average of 5.03 illustrates that the majority of respondents indicated working with text-messaging saves a lot of time (Q4). Less than 23 respondents selected 3 or less as an option for the question. Stronger support for clarity of using text-messaging was illustrated with a rating average of 1.64, which meant that the respondents disagreed with the idea that text-messaging, was confusing (Q1). The respondents were split on the idea of using text-messaging as an aid to learning, as noted by the rating average of 3.69 of Question 2. Also, as observed in Question 3 (rating average of 2.67), approximately half of the respondents believe that technological things happen when using text-messaging (and they do not know why). Overall, as referenced in Question 5, with a rating average of 1.85, the respondents do not find issues related to text-messaging to be frustrating to them.

Results for Research Question 2: Out of the available selections of communications media, how was text-messaging viewed as a medium for interpersonal task completion, specifically with regard to AHS?

Anchoring vignettes provided contextual hypothetical scenarios that allowed the respondents to

state their preferred source of AH and whether or not they would use text-messaging, expressed as their BI to use, in the context of this study. Three vignettes were developed for this study. The first vignette depicted a student who is struggling in a Biology class and summarily needs AH. The second vignette depicted a student with personal family issues that were beginning to affect the student's grades. The third vignette depicted a student with a problematic roommate whose antics were creating an environment where the student cannot study, thus resulting in a drop in the student's grades.

Scenario 1:

"Your Biology Professor has announced a final exam worth 75% of your grade that will be given at your next class meeting. You are struggling with the course and desperately need to pass this upcoming exam. Your professor has given you several options if you need help preparing for the exam. First, the professor recommends reporting to the Biology lab for FtF peer learning and tutoring with other Biology students outside of class. The professor also will be available for a one-hour virtual review session of the material covered in class where you can contact him/her by instant messaging (IM). You also are given the option to send the professor an e-mail where you can ask questions and seek additional study tips. Your professor also provided a cell phone number where you can call or send a text-message with any questions prior to the exam. You also have friends who are serious Biology students that you could solicit for help."

Text-messaging was found to be a very popular based on the respondents' data that was received previously from the open-ended questionnaire. Surprisingly, only a total of (n = 15) 5.5% of the respondents stated that they would use text-messaging to seek AH in this scenario. However, the majority of the respondents (n = 257) 93.7% indicated that they would not use text-messaging for AHS and a negligible total of respondents (n = 2) 0.8% stated they would not seek AH at all in scenario one. Table 2 summarizes the full distribution of BI to Use text-messaging in this context.

Table 2: Behavioral Intention to Use Text-Messaging for Seeking Academic Help (Scenario 1)

In this scenario		
Answer Options	Response Percent	Response Count
I would utilize text-messaging	5.5%	15
I would not use text-messaging	93.7%	257
I would not seek any help at all	0.8%	2
Answered question		274
Skipped question		39

Scenario 2:

"*Due to personal issues involving your family, your grades have suffered since you have not been spending enough time on your studies. You could e-mail the school counselor and speak with her about these issues that are affecting your grades, or you could visit her in person to seek help. You could text or instant message (IM) your friends to seek help or advice. You have friends in your classes that you could study with in person so you can get caught up and improve your grades. There are others you may be able to call on the phone who would be willing to help you during this difficult period as well."*

As with vignette one, a large percentage of the respondents (n = 234) 88.0% indicated that they would not use text-messaging in this AHS scenario, while (n = 8) 3.0% revealed that they would not seek help at all for scenario two as illustrated in table 3. Only a total of (n = 24) 9.0% of the respondents stated that they would use text-messaging for AHS purposes in this scenario as illustrated in table 3.

Table 3: Behavioral Intention to Use Text-Messaging for Seeking Academic Help (Scenario 2)

In this scenario		
Answer Options	Response Percent	Response Count
I would utilize text-messaging	9.0%	24
I would not use text-messaging	88.0%	234
I would not seek any help at all	3.0%	8
Answered question		266
Skipped question		47

Scenario 3:

"Your roommate seems to repeatedly make irresponsible decisions and then calls on you to bail him/her out of these situations. You frequently lose sleep and are fatigued as a result of being a nursemaid to your roommate, thus causing your grades to slip. You are on a full academic scholarship and you must maintain a certain grade point average to maintain your eligibility. You need to speak with someone to get advice on how to deal with your roommate and preserve your academic scholarship. You could seek online help from a college official by e-mail, contact your residence community coordinator (RCC) by IM, visit the school counselor in person, call a parent by phone, or text a friend for advice."

The results from the third vignette yielded that text-messaging again slightly increased in frequency as it was selected by (n = 24) 9.2% of the respondents. But again, it did not meet or surpass the level of respondents (n = 222) 84.7% who indicated that they

would not use it in this scenario to seek AH. A total of (n = 16) 6.1% revealed that they would not seek AH at all for scenario three as revealed in table 4.

Table 4: Behavioral Intention to Use Text-Messaging for Seeking Academic Help (Scenario 3)

In this scenario		
Answer Options	Response Percent	Response Count
I would utilize text-messaging	9.2%	24
I would not use text-messaging	84.7%	222
I would not seek any help at all	6.1%	16
Answered question		262
Skipped question		51

Results for Research Question 3: What are the characteristics of college students who prefer text-messaging to complete the task of AHS?

The data were derived from part one of the CUSE instrument by Cassidy and Eachus (2002) that also measured EUT for the five communications technologies utilized in this study was cross-tabulated with data from a demographic collection instrument in the following categories: gender, race/ethnicity, class rank, and membership in special populations. The following discussion of RQ3 offers conclusions of the cross-tabulated data results for each category.

a) Gender and Technology

Results observed when examining the various demographic groups and which preferred text-messaging to complete the interpersonal task of AHS were revealed using cross-tabulation. The sample consisted of a nearly equal distribution of females (n = 133) 50.7% and males (n = 126) 48.0% respectively. With regard to gender and technology, females respondents indicated more experience using technology overall than the male respondents. However, the levels of competence varied by gender. In an examination of text-messaging, both males and females were very close to equal in their level of experience, specifically as males reported "Quite a lot" of experience with text-messaging (n = 26) 10% and females (n = 27) 10.4%. Text-messaging was highly popular among the respondents 70%. This high response rate seems justifiable as the respondents reported that more than 98% of them owned cell phones.

b) Race/Ethnicity and Technology

Results observed when examining the demographic "race/ethnicity" when cross-tabulated yielded interesting observations. Cumulatively, each of the racial/ethnic groups responded at a rate of 80% or more that they had "quite a lot" or "extensive" experience using text-messaging.

c) Special Campus Populations and Technology

An examination of text-messaging yielded a high response across all special categories and the belief that they have a great deal of experience using it 94%. Although text-messaging was extremely across all groups popular, it was not deemed preferable for the purpose of seeking AH.

V. Discussion

Pertaining to CUSE and EUT, this generation of young adults is extremely comfortable with technology. This is evident from the data obtained from the 6-point Likert-scale instrument and the forced-choice ordinal scale instrument by Cassidy and Eachus (2002) for measuring CUSE and EUT. The mean scores from the 6-point Likert-scale instrument for measuring CUSE indicated that the majority of the respondents described themselves as skilled, competent, and comfortable with text-messaging.

Three scenarios (vignettes) were administered to the respondents that ultimately prompted a need to seek AH. Upon viewing each vignette the respondents were then asked to state whether or not they would utilize text-messaging to seek AH in the given scenario.

Scenario One

Vignette one dealt with the respondents reacting as a student on the verge of failing a difficult course. Text-messaging was viewed as popular and favorable as a form of communication among practically all of the respondents; however, they did not find it to be an ideal mechanism to facilitate the AHS task. Although extremely popular as a social networking communications method, text-messaging was believed to allow for misinterpretation in communication and it was also identified as an impersonal method of communication for more serious and formal encounters. In sum, the respondents stated that text-messaging was too informal and impersonal to be an effective AHS choice for scenario one.

Scenario Two

Upon viewing vignette two, the respondents reacted as another student who was also struggling to maintain his/her grades, but there was an additional underlying root cause of personal family problems that attributed to the student's academic peril. It is possible that the additional personal family problems element prompted a number of the respondents to favor the applicability of text-messaging, as a help-seeking mechanism, more favorably in this situation than in the previous scenario. If informal contact with friends or family would be the preferred means to seek help in this instance then text-messaging would have perhaps been a sensible choice.

Scenario Three

Upon viewing vignette three, the respondents were viewed as a student who was living with an irresponsible roommate whose antics ultimately began to take its toll on the respondent's grades. The responses from the open-ended questionnaire and vignette for scenario three seemed to suggest that text-messaging appeared to be favored for brief, informal communications among close friends, family members, and endeared inner texting circles, while being discouraged for use within more structured, formal communications. Furthermore, conclusions of the findings suggest that text-messaging doesn't appear to offer the same value for completing the interpersonal task of AHS as a high social presence communications media might such as face-to-face (FtF) and the telephone.

Conclusions drawn from cross-tabulated demographic data and EUT indicate that the majority of the respondents have a great deal of experience with text-messaging making them proficient and comfortable with the use of it. Overall, females reporting in this study appear to have more experience with text-messaging and as such, would conceivably use it more than males. Across racial boundaries, over 80% of the respondents reported a great deal of experience with text-messaging and in the case of the present study, blacks indicated higher frequency for experience than whites.

This is attributable to the fact that the student population of the target institution has a disproportionate black to white ratio in favor of black students. Only 13 respondents self-identified as Hispanic and reported either "quite a lot" or "extensive experience" with text-messaging. This study was not conceived to be ethnographic and therefore race and ethnicity concerns are actually beyond its scope. However, since the target institution had a high racial demographic in favor of African Americans, the data was additionally cross-tabulated by race/ethnicity and it is felt that this data was worthy of at least brief mention in this conclusion section.

More freshmen responded to the surveys than sophomores in this study. However, freshmen and sophomores expressed similar beliefs in their experiences with text-messaging. The age difference between traditional college freshmen and sophomores is small, typically with no more than a two year difference which could explain their similarly stated experience with text-messaging.

Across special campus populations, student athletes were the largest group represented followed by extracurricular groups. At the target institution, student athletes comprise approximately 60% of the entire student body. This disproportionate ratio explains the high student athlete response rate for this study. All groups surveyed, including student athletes, expressed that they had a great deal of experience with text-messaging. Since well over 90% of all respondents indicated ownership of a cell phone, this would explain the high rates of experience and comfort-level reported for text-messaging across all demographic groups. Text-messaging was used extensively among all groups surveyed in this study, however, the findings revealed that it was not the most favored communications media for the interpersonal task of seeking AH. Even though the popularity of text-messaging has superseded all other popular communications media commonly used today as the preferred means of communication among college students, the age demographic of traditional college students reinforces the conclusion that technology that is perceived to be outdated and not "hip" will typically be shunned in favor of newer, trendier technology.

DePaulo and Fisher (1980) looked specifically at female college students in their study and found that the female participants were reluctant to seek help during that period. However, taking into consideration that DePaulo and Fisher conducted their study over 30 years ago, current literature has shifted the reluctance to seek help to collegiate males, as females have now been found to be more receptive to seeking formal help (Tsan & Day, 2007; Vogel, Wester, & Larson, 2007). Summarily, the findings of the current study provide ongoing support for the conclusion from DePaulo that potential help-seekers take into consideration the psychological cost of seeking assistance.

VI. Conclusion

This study has several implications across the fields of information systems (IS), education, and psychology. From an IS perspective, this study endeavored to ascertain if text-messaging could possibly be used in an unconventional way to achieve the task of AHS. This study also identified a gap in the scholarly research on text-messaging as a relatively new technology, despite its immense world-wide popularity. The results of this study also attempted to reveal any gaps among a variety of groups with regard to access to technology, ownership of technology, and skill and experience level with technology.

The findings of the current study are significant in the fact that despite its popularity among college students the world over, the college students who participated in this study were reluctant to use text-messaging for the important self-initiating interpersonal task of AHS. Although this study sought to contribute to the scholarly body of knowledge (BoK) within information systems, a main component of this research has an overarching help-seeking element within it and help-seeking is a behavioral condition that is firmly rooted in psychology. Therefore, the results and conclusions drawn from this work should also benefit teachers, learning specialists, and school psychologists.

VII. Future Work

Ample opportunities for continuing research are revealed as a result of this work. Of course, generalize ability is an important factor as older age groups should be examined with regard to communications technology usage. Future research could also include replicating this work in a business related unit where text-messaging is heavily utilized in a team environment. Situating the study or conducting a similar study in another interpersonal context other than AHS would be highly informative as well. As with older age groups, individuals who fall outside the ages of traditional college students such as adolescents and senior citizens would offer a different perspective on BI to use text-messaging. Because the sample size for the current study was relatively small, this study should be conducted again in a larger environment with a more sizable population to see if the results and conclusions drawn are similar, the same, or vastly different than the results and conclusions attained here. And finally, more research is needed on text-messaging in particular, due to the fact that it is a fairly new technology and hence, there is a vast amount of unexplored territory to be addressed in the scholarly literature.

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From Silicon Chips to Carbon Nanotubes

By Mona Nabil Elgohary, Prof. Dr. Mostafa Sami, Dr. Hala Abdelgalil & Dr. Wesam Elbehidy

Abstract- Nanotechnology is the science that deals with material in the nanoscale dimension. One of the most interesting nanomaterials today is Carbon Nanotubes. This paper contains two parts; the first part summarizes Nanotechnology and Nanoscience by illustrating the history, the technology concepts, the application areas and the commercial products, while the second part explains Carbon Nanotubes; its formation, classes, properties, and its nowadays potential uses.

Keywords: component; nanotechnology, nanoscience, carbon nanotubes, nanometer, nanoscale dimension, nanoscale transistor.

GJCST-G Classification: J.2 K.4.4

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Strictly as per the compliance and regulations of:

From Silicon Chips to Carbon Nanotubes

Mona Nabil Elgohary [α], Prof. Dr. Mostafa Sami [σ], Dr. Hala Abdelgalil [ρ] & Dr. Wesam Elbehidy [ω]

Abstract- **Nanotechnology is the science that deals with material in the nanoscale dimension. One of the most interesting nanomaterials today is Carbon Nanotubes. This paper contains two parts; the first part summarizes Nanotechnology and Nanoscience by illustrating the history, the technology concepts, the application areas and the commercial products, while the second part explains Carbon Nanotubes; its formation, classes, properties, and its nowadays potential uses.**

Keywords: component; nanotechnology, nanoscience, carbon nanotubes, nanometer, nanoscale dimension, nanoscale transistor.

I. Introduction

Nanoscience and Nanotechnology are the future of engineering, materials, and related sciences. "Nano" means very small, so nanomaterials can be constructed atom-by-atom; with different techniques (ex: a bottom-up technique). The information about the bottom-up process is embedded in the material building blocks so that these can self-assemble in the resulting product.

Also, at the nanometer scale, the properties of the material, such as its electrical conductivity, its weight, its color, and its strength, change. The consequence is that a material when in a bulk form; big pieces of materials found around us can have properties which are very different from that nano-sized form. At nanoscale dimension, the principles of classical physics don't don't can describe their behavior (their movement, their energy). At this dimension, the quantum mechanics principles are used. For instance, bulk silver is non-toxic, while Nano silver is toxic and can kill viruses upon contact.

Furthermore, Nanomaterials have an increased surface –to-volume ratio compared to bulk materials. All processes that occur at the material surface, such as catalysis and detection. The surface-to-volume ratio is significant [8].

II. From Nanoscience to Nanotechnology

First, The Nanoscience is commonly defined as: "the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale" [8].

So, the same material (e.g., gold) at the nano-scale (nano gold) can have different electrical, optical, and magnetism properties (even opposite too!) from the properties the material has at the macro scale (bulk).

Nanoscience is considered as "multidisciplinary science", which means that it combines concepts of many sciences such as biology, biotechnology, and engineering. Therefore, Nanoscience is a "horizontal-integrating science that cuts across all vertical sciences and engineering disciplines" as shown in figure 1 [8].

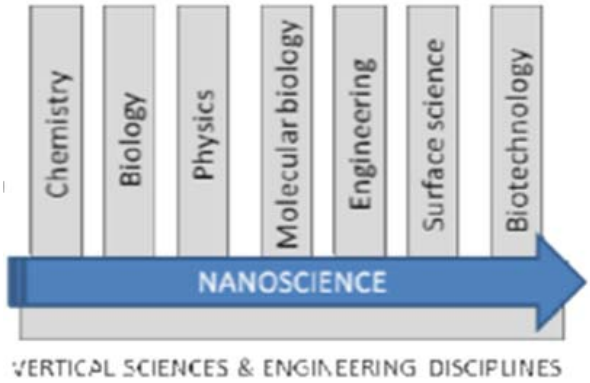

Figure 1: Nanoscience Disciplines [8]

Nanotechnology is the application of Nanoscience in commercial products and many industries (Figurer 2).

III. Nanotechnology

a) Introduction

The Nanotechnologies is commonly defined as: "the design, characterization, production, and application of structures, devices, and systems by controlling shape and size at the nanometer scale." [8].

As shown in Figureure 2, Nanotechnology cuts "horizontally" across many industrial areas and "enables" the platform and the tools to realize certain products and because it brings together previously separated sectors of science, it is "convergent" [8].

b) Nanotechnology History

The idea of nanotechnology was firstly highlighted in 1959 when the Nobel Prize winner, Richard Feynman, said, "There is plenty of room at the bottom" in his talk at the Californian Institute of Technology at the meeting of the American physics society. He expected that it is possible to control materials at a very small scale. So, new areas of scientific research would be introduced.

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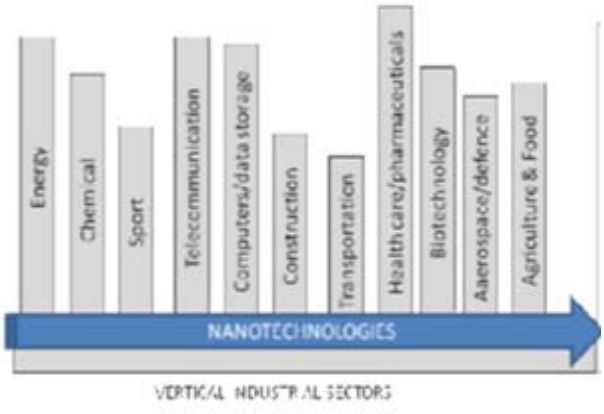

Figure 2: Nanotechnology [8]

In 1974, nanotechnology term was first suggested by Norio Tangichi from Tokyo University of Science, while the main details of this technology were explored by Eric Drexler 's book "Engines of Creation – The Coming Era of Nanotechnology" in 1986.

Since 1980's, key discoveries of new nanotechnology-enabled materials, nanomaterials (see table1), resulted in developments in many fields including quantum dots, "buckyballs" (i.e. fullerenes or carbon nanotubes), and a range of other new materials and additional applications.

Many of those nanomaterials can support many areas of applications for improving already available products and processes or designing completely new ones.

Fullerenes are a good example; it is a new class of carbon material at the nanoscale, called nanocarbon, with the new chemical, electrical and physical properties. They are very strong mechanically but also flexible and consider as an excellent conductor. It can be used in many applications, like solar cells, various coatings, sports equipment, memory chips etc. [2].

Figure 3: Nanometer

c) Nanotechnology Concepts

- Nanometer

One billionth of a meter (10-9 m) is one nanometer. The nanometer scale (as shown in figure 3) is defined as 1 to 100 nm. The range is set normally to be minimum 1 nm to avoid single atoms or small group of atoms being designated as nano-objects. So, Nanoscience and nanotechnologies deal with groups of atoms of minimum1nm size.

The nanometer's upper limit is normally 100 nm but it is not an accurate limit because objects with greater size (up to 1000nm) are defined also as nanomaterials [8].

Nanomaterial

A nanomaterial object is an object that has at least one dimension on the nanometer scale (approximately 1- 100nm). According to their dimensions, nanomaterials are classified into 3 groups as shown in table 2 [8].

Table 1: Nanotechnology Developments Milestone

Nanomaterial Dimension	Nanomaterial Type	Example
All three dimensions < 100 nm	Nanoparticles, Quantum dots, nanoshells, nanorings, microcapsules	
Two dimensions < 100 nm	Nanotubes, fibres, nanowires	
One dimension < 100 nm	Thin films, layers and coatings	

Table 2: Nanomaterials Groups

Year	Development Milestone
1959	Nobel prize winner in physics Robert Feynman's "There 's plenty of room at the bottom"
1966	Quantum confinement effect discovered by Alan Fowler and colleagues at IBM
1974	"Nanotechnology" concept presented by Norio Taniguchi of the Tokyo University of Science
1981	STM (Scanning Tunneling Microscope) invented by Gerd Binning and Heinrich Rohrer of IBM, US
1982	Quantum dot, laser application proposed by Yasuhiko Arakawa and Hiroyuki Sakaki , the University of Tokyo
1984	Fullerenes found out by Richard Smilley and colleagues of Rice University in the US
1986	AFM "Atomic Force Microscopy" invented by Gerd Binning and colleagues at IBM
1986	Eric Drexler of the MIT, "Engines of Creation: The Coming Era of Nanotechnology" US publishes.
1986	Foresight Nanotech Institute established as the first one to educate society about the benefits and risks
1987	First commercial STM shipped by Digital Instruments in the US
1989	First commercial AFM shipped by Digital Instruments in the US
1990	The "IBM" logo produced with individual atoms for promotional reasons
1991	Carbon nanotubes discovered by Sumio Ijima of NEC, Japan
1991	AFM used on living cells, stimulated the cross-pollination between nano- and biotechnology
1990s	China adds nanotechnology to its S&T priorities in the 863 National High Technology Program at MOST
1999	Discovery of dip-pen nanolithography by Chad Mirkin at Northwestern University in the US
2000	The Center for Nanotechnologies at the Chinese Academy of Sciences opens in Beijing
2001	National Nanotechnology Initiative launched in the US
2002	Nanotechnology Research Network Centre of Japan established
2002	The European Commission designated nanotechnology a priority area in the Sixth Framework Program
2004	The "21st Century Nanotechnology Research and Development Act" in the US providing further funding
2005	The Japanese "Strategic Technology Roadmap" published
2006	The 3rd Science and Technology Basic Plan" launched in Japan
2006	The EU "Roadmaps at 2015 on Nanotechnology Application" published
2007	Russia announces USD 8 billion investment in nanotechnology from 2007-2015
2008	The US "Technology Roadmap for Productive Nanosystems" published
2008	Korean "Nanotechnology Roadmap" published

d) Nanotechnology Approaches

Nanotechnology has emerged from gathering many disciplines like chemistry, physics, and biology through the joint realization of new chances of research at the nanoscale. There are two used approaches; Figure 4explain the steps of both top-down approach and bottom-up approach [2].

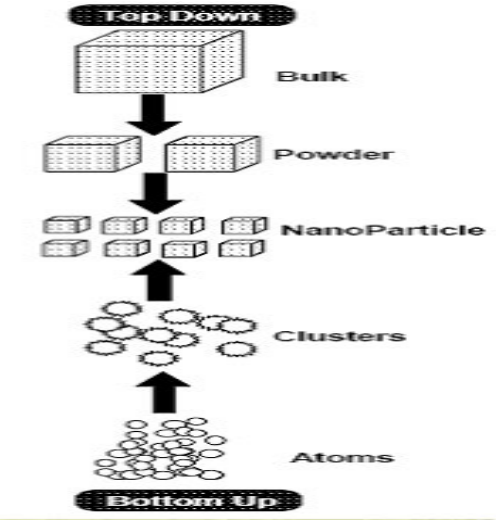

Figure 4: Top-Down and Bottom-Up Approaches

To have a nano particle using top-down approach, the bulk material will have a successive cutting or slicing until reaching nanoscale. On the other hand, "bottom-up" approach refers to construct the material atom by atom, molecule by molecule or cluster by cluster. This builds-up a material from the bottom [11].

e) Nanotechnology Application Areas

- Drug-Delivery Technique

Dendrimers are a type of nanostructure that can be used in a wide range of applications, For example, the treatment of the diseases like cancer. Dendrimers have a great advantage; it can do many things simultaneously: recognizing diseased cells, diagnosing diseased states (including cell death), drug delivery, and reporting outcomes of therapy.

- Nanofilms

Nanofilms have many uses nowadays; on computer screens, glasses, and cameras to protect or fix the surfaces. Several nano-elements are used in thin films to have many enhanced features like water resistant, self-washing, anti-reflective, infrared-resistant, anti-microbial, steam-resistant, anti-scratch-, and enhance its electrical conductivity. 1].

- Water Filtration technique

Carbon nanotubes for water desalination and nanoscale sensors can be widely used to identify pollutants in water networks. There is also titanium dioxide (TiO_2) which is a nano-material that has great use for water filtration and water purification [3].

- Nanoscale Transistors

Transistors are the electronic gates where a small amount of electric power is used to manage the flow of higher amount of electric power. In computers, providing more transistors will result in a more powerful computer.

With the decrease in transistor size, computers are becoming more powerful. Until recently, a computer chip with the best commercial technology has transistor sizes from 32 nano to 45 nano [1].

- Nanotechnology and Space

Nanotechnology may be the promising technology for making the space-flight. Developments in nanomaterials result in solar sails, shown in figure 5(a) [14], and a wire that can be used for the space elevator, figure 5 (b) [15]. In addition, combining robots and sensors with new nano-materials can enhance the performance of spaceships, spacesuits, and the tools of exploring planets and moons. [5].

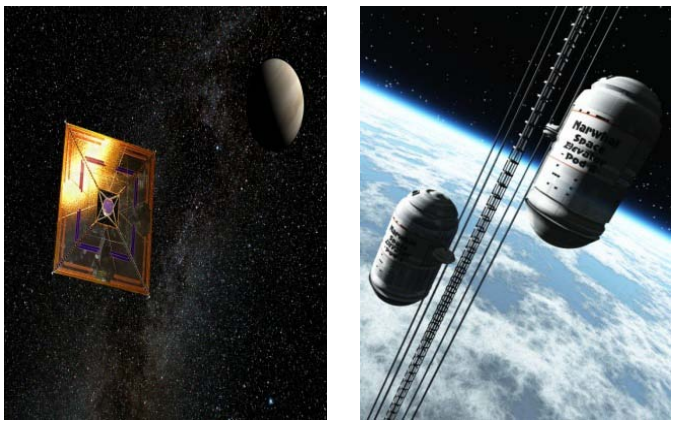

Figure 5: a) Nano Solar Sails b) Space Elevator

f) Nanotechnology Commercial Products

- Anti-Bacterial Products

One of the most common instances, as shown in figure 6, `is the use of silver (Ag) in consumer products as anti-microbial. By combining nanoscale silver into household appliances, textiles, and plastics can kill bacteria without affecting the properties of the products [5].

Figure 6: "Benny the Bear" plush toy Sports Jersey from Sinotextiles Co, Ltd, Ltd Silver Seal computer keyboard

- "Samsung "Silver Nano" Washers

It is an advanced washing technology with the capability of the super killing of bacteria .it has 400 billion silver ions dissolved in water to make an extreme cleaning solution that affects the clothes at an almost nano level.

Figure 7: Samsung Silver Nano Washer

Samsung silver nano washer, shown in figure 7, has a sterilizing the ability to 99.99% and lasting antibacterial action will redefine the idea of pureness. It uses 99.99% pure silver for a lasting improvement in your health and garments [7].

- BMC: lighter and stiffer frames with Easton nanotubes

Carbon Nanotubes (CNT) technology has powerful possibilities, for instance, this bike frame on the BMC SLC01 Pro Machine that weighs 2.1 lb., or about as much as five cell phones. its makers said: " that is Tiny tubes of carbon fiber nanotubes are mixed into the resin which bonds the carbon sheets together, figure 8, and work to add strength to the resin much like using wire-mesh in concrete does" [6].

Figure 8: BCM

- Boeing 787 –50% Composite

When two or more materials are used together to give a combination of properties this is called composite. Composite materials may be selected to give unusual combination performance, corrosion resistance, conductivity or hardness.

The Boeing 787 makes greater use of composite materials, as shown in figure 9, in its airframe and primary structure than any previous Boeing commercial airplane by comprising nearly half carbon fiber-reinforced plastic and other composites.

The result is an airplane that offers 20 percent weight savings compared to more traditional aluminum designs [3][4][10][21].

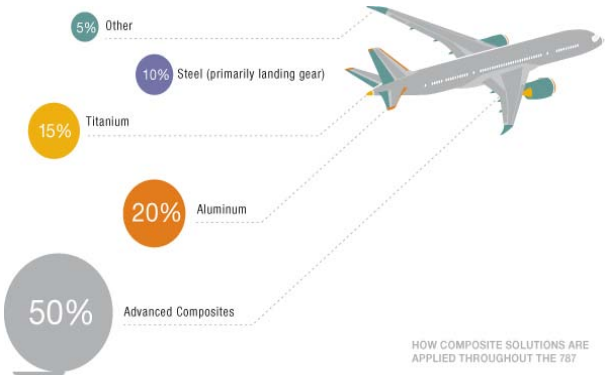

Figure 9: Boeing 787- 50% Composite

IV. Carbon Nanotubes

a) Introduction

In 1991, Sumio Iijima discovered carbon nanotubes, as in table 1.They are long, thin cylinders of carbon atoms which are novel for their size, shape, and extraordinary physical properties.

Carbon Nanotube is an excellent example of true nanotechnology: it has a very small diameter (less than 100 nanometers and can be as thin as 1 or 2 nm). It is a material that can be manipulated chemically and physically in very useful ways. It has important properties, such as extraordinary heat conductivity, electrical conductivity, and mechanical properties, and its high length-to-diameter ratio. These properties make it very useful in a wide range of applications in chemical processing, biology, electronics, energy management, and many other fields to be developed [12].

b) Nanotube Formation

Carbon (C6) is the 4th most available element in the Universe by mass after Hydrogen, Helium, and Oxygen with an atomic number of 6. It forms more than 10 million organic composites, which makes carbon the chemical basis of all known sort of life [12].

Carbon is an exceptional element which may exist in many stable forms from 3D diamond to 2D graphene to 1D nanotubes and 0D fullerenes (Buckyballs). In figure 10 these forms are shown. [13].

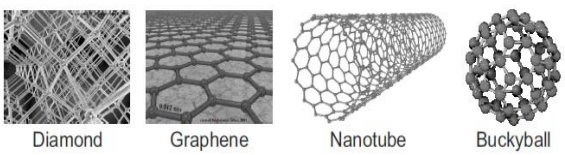

Figure 10: Carbon Forms: 3D Diamond, 2D Graphene, 1D nanotube, 0D Buckyballs BCM

As shown in figure 11, the carbon nanotube is constructed by some carbon atoms (graphene) that are bonded together in a hexagonal network. Then this graphene rolled into a cylinder and form a carbon nanotube. Based on the physical design of the tubes, their electric, thermal and structural properties can change [12] [13].

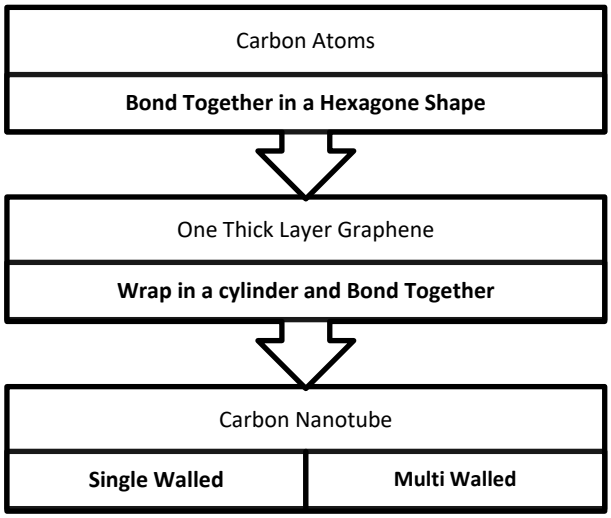

Figure 11: Carbon Nanotubes Formation

c) Carbon Nanotubes and Moore's Law

According to Moore's Law, by 2019, the transistor's dimension will be just a few molecules. The improvement from a mini, to micro to 45 nm scale has already known. Carbon Nanotubes have diameters of only 1 to 2 nm, seems to be one of the perfect applicants to deliver us to the end of Moore's Law curve [12].

d) Nanotubes Classes

Nanotubes can be Single-Walled Nanotubes (SWNT), or can have Multi-Walled Nanotubes (MWNT) – cylinders inside the other cylinders. The MWNT were the first to be discovered (1991) while SWNT were discovered two years later (1993) [15].

- Single-Walled Carbon Nanotubes

A single-walled carbon nanotube can be described as a single sheet of carbon atoms (graphene form) which are located on a hexagonal lattice, has a typical diameter of 1 – 2 nm rolled up into a seamless hollow cylinder [13].

There are three assorted designs, figure 12, can be used to form the single walled nanotubes: armchair design, chiral design, and Zigzag design.

Figure 12: Single Walled Carbon Nanotubes (Graphene) Sheet with the possible rolling designs (Zigzag and Armchair)

The design depends on how the graphene is wrapped into a cylinder. Rolling a sheet of graphene from its corner results in one design. While rolling the graphene from its edge results in another one. Figure 13 shows how the designs of zigzag and armchair are rolled.

The chiral vector) (n, m) represents the design of the nanotubes. [12] [15]. Figure 12 shows that zigzag design is getting when the index m in rolling vector is constant (i.e. zero) while index n changes. The indices in Armchair design changes with the same rate, while the indices in chiral design changes differently.

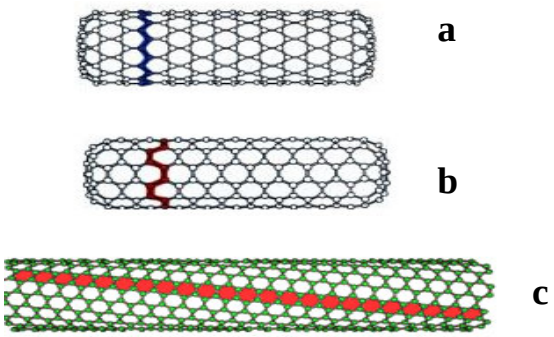

Figure 13: Single Walled Nanotubes Designs according to chiral vector a) (n, 0) Zigzag b) (n, n) Armchair c) (n,m) Chiral [9].

Figure 13 is a real atomically resolved image of a chiral nanotube, Figure 12 c, as observed in STM (Scanning Tunneling Microscope) experiments. Measuring chirality and the diameter (i.e. height) of the nanotube, one can uniquely characterize the nanotube under study [9].

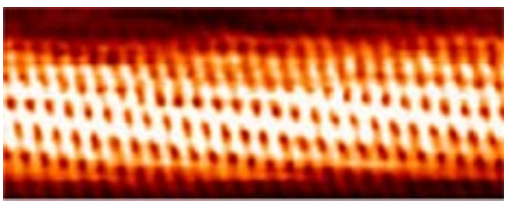

Figure 14: Microscopic Image for Chital SWNT

Nanotube's electrical properties are affected by the structural design. For example, when (n, m) is a multiple of 3, it has an Armchair design described as "metallic" and it is highly conducting, as figure 15(a). Otherwise, the nanotube is a semiconductor, when it has Zigzag design and Chiral Design, as in figure 15(b) [17] [14].

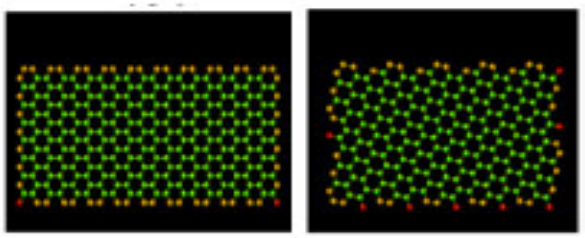

Figure 15: a) Armchair Design b) Chiral Design Metallic High Conductivity Semiconductor

- Multi-walled carbon nanotubes (MWNT)

Parchment model and Russian Doll model are two structural models of multi-walled nanotubes.

Figure 16 shows Parchment model where a single sheet of carbon is rolled around itself more than one times.

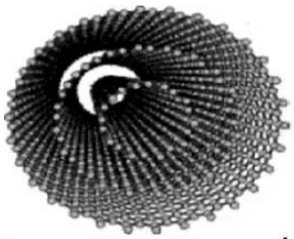

Figure 16: Parchment Model for MWNT

Russian Doll model, figure 17, a carbon nanotube contains another nanotube; the inner tube has a smaller diameter than the outer one.

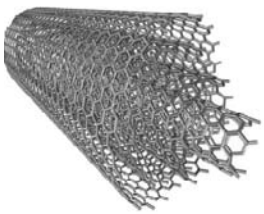

Figure 17: Russian Model for MWNT

Multi-walled carbonNanotubes have same properties as single-walled nanotubes but in multi-walled nanotubes, the outer wall protects the inner one from interacting chemically with outside materials. Furthermore, multi-walled nanotubes also have a higher tensile strength than single nanotubes [13].

e) Nanotubes Properties

- Strength

There are sp2 bonds between the individual carbon molecules, and this bond is even stronger than the sp3 diamond's bond. This means the tensile strength of carbon nanotubes have a higher than steel and Kevlar. Individual carbon tubes can bond together under high pressure, converting some sp^3 bonds to sp^2. This means producing a nano-wire becomes possible.

Carbon nanotubes are not only strong but also they are flexible. You can press on the tip of a nanotube and cause it to bend without breaking the tube and it will return to its original shape when the pressure is removed. [12].

Based on this property, there are many uses of nanotubes like waterproof and tear resistant cloth fabrics, concrete and steel like applications (a space elevator)

- Electrical Properties

As mentioned in figure 15(a, b), carbon nanotube's design effects its conductivity power. Nanotubes become high conductive when the formation of carbon atoms reduces the collisions between electrons and atoms.

Carbon nanotubes also have the ability to carry higher electric currents than copper because of their sp2 bonds between carbon atoms.

Furthermore, when carbon nanotubes are used for interconnection of semi-conducting devices it can transfer electrical signals at speeds up to 10 GHz [12]. Based on this property, there are many uses of nanotubes like electrical circuits

- Thermal Properties

The strength of sp2 bonds between the carbon atoms enables them to withstand high temperatures. so, nanotubes can be used as thermal conductors and transfer more than 15 times the amount of watts per meter per Kelvin compared to the commonly used copper wire. Based on the tubes' temperature and its environment, the nanotube's thermal conductivity may change [12].

Based on this property, there are many uses of nanotubes like: sensors, vacuum proof food packaging.

f) Nanotubes Potential Uses

Here are some uses of Carbon Nanotubes:

- Batteries

Nowadays, "Rechargeable Lithium-Ion Batteries" are the most used batteries for most portable electronic devices. These batteries contain two electrodes, the first one is graphite and the second is the metal oxide. When lithium ions move between these two electrodes, the batteries release charge.

At the "University of North Carolina", [12, 15] the researcher have proved that the storage capacity can imply doubled by replacing the graphite with single-walled carbon nanotubes.

Carbon nanotubes electrodes have many advantages; they can be ten times lighter and thinner

than carbon electrodes and they have a conductivity power that is more than one thousand times greater.
In some cases like electric vehicles, the reduction in weight can make a great reduction in power requirements of the battery.

Carbon nanotubes are used in supercapacitors producing a power cycle of 30kw/kg while the best commercial devices result in only 4kw/kg. The best usage of these nano- capacitors is in laptops and cell phones because these capacitors take less time to recharge devices.

- Solar Cells

Researchers at the Georgia Institute of Technology [12] used carbon nanotubes implanted on iron-coated silicon chips to build towers with a height of 200 μm. This tower is a group of thousands of carbon nanotubes with vertical alignment, and these towers are the main part of nanotubes new solar cells. single square centimeter, cm2, of a single solar cell's surface contains forty thousand, 40,000 of these towers.

These cells absorb more light and then reflect it towards the sides of the towers. And also the nano-particles solar cells have two peaks at 45 degrees and operate with relatively high efficiency during most of the day. While the traditional solar cells that have peak efficiency only when the sun is at 90 degrees. This makes nanotube cells particularly suitable for space applications because there is no mechanical way to change the angle to face the sun.

- Nano-Electronics

The most important areas of possible applications where single-walled nanotubes can be used are nano-electronics because nanotubes have high electrical conductivity. CNT can also be considered the most famous conductive carbon fibers.

Alternative designs for carbon nanotubes can lead to semiconducting materials, such as silicon.

Based on the degree of volatility - the degree of growth and size of nanotubes - conductivity in nanotubes may be very high making nanotubes the best suitable element for interconnection between electronic circuits

- Interconnect

Microchip industries need metal compounds to act as the main transistor connections on fine chips. Initial designs used aluminum to connect transistors, then change to copper.

A few years later, copper technology will be inefficient to connect circuits because there are some expectations that high-performance chips that are connected to more tightly packed transistors will need interconnections with 40 nm or less in width, which can be achieved using carbon nanotubes.

Toshiba and Stanford University[12,13] recently announced results proving that the operation of a nanotube-based interconnects at 1Ghz on a chip carrying 11000 transistors on a microchip the size of 1/100th of a square inch[12,16].

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Culture Context Profiles: A Case of Institutional Websites in Nigeria

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Abstract- Criticisms owing to rigidity and obsoleteness has been directed to the hallowed positions (and often cited) cultural models proposed by Hall and Hofstede. This is largely because globalization and culture are verily fluid, amorphous and always in transition; and not defined by geographical borders existing between countries. In this paper we consider the cultural contexts of several websites owned by commissions/agencies of the Nigerian Government, using recent improvements of Hall's and Hofstede's model because their dimensions did not include Africa. Specifically, we evaluated we evaluate websites of the Cooperate Affairs Commission of Nigeria, Federal Inland Revenue Service of Nigeria, National Agency for Food and Drug Administration Commission of Nigeria, National Pension Commission of Nigeria, Nigeria Export Promotion Commission, Nigerian Tourism Development Corporation, National Emergency Management Agency of Nigeria so as to determine their cultural context profiles. In order to actualize these we employed the online survey methodology by distributing questionnaires to different groups of experts drawn from the various regions of Nigeria.

Keywords: *website, culture contexts, e-governance.*

GJCST-G Classification: *H.3.5*

Strictly as per the compliance and regulations of:

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Ikechukwu Umeh [α] & Chukwunonso Nwokoye [σ]

Abstract- Criticisms owing to rigidity and obsoleteness has been directed to the hallowed positions (and often cited) cultural models proposed by Hall and Hofstede. This is largely because globalization and culture are verily fluid, amorphous and always in transition; and not defined by geographical borders existing between countries. In this paper we consider the cultural contexts of several websites owned by commissions/agencies of the Nigerian Government, using recent improvements of Hall's and Hofstede's model because their dimensions did not include Africa. Specifically, we evaluated we evaluate websites of the Cooperate Affairs Commission of Nigeria, Federal Inland Revenue Service of Nigeria, National Agency for Food and Drug Administration Commission of Nigeria, National Pension Commission of Nigeria, Nigeria Export Promotion Commission, Nigerian Tourism Development Corporation, National Emergency Management Agency of Nigeria so as to determine their cultural context profiles. In order to actualize these we employed the online survey methodology by distributing questionnaires to different groups of experts drawn from the various regions of Nigeria. Finally, the results showed that, most website designers in Nigeria follow the high context style in terms of animation, promotion of values, level of transparency, navigation, multiple use of links, color, search and polite/direct approach in actualizing their websites.

Keywords: website, culture contexts, e-governance.

I. Introduction

The proliferation of internet use coupled with the increasing number of web designers has positively affected institutions in showcasing and achieving their dreams on the World Wide Web through their websites. The marketing industries mostly, were quick to adopt this approach since it provided a batter platform for showcasing their goods and services to both local and foreign customers. Recently, websites have gone beyond simple static and text-based styles to dynamic and interactive styles with multimedia possibilities like; the addition of flash, sound and video. There by, setting a higher level of quality for better communication through the web. However, in order to create a cross-cultural satisfactorily website from a marketing perspective, designers must deal with issues that surround "culture-specific color connotations, preferences in layout, animation, sounds, and other effects that are characteristic of today's generation of Web sites" [7]. This stand point is maintained to a large extent for e-government websites which basically strive to provide a citizen-centric tool for effective and efficient service delivery by government agencies. Studying user dispositions to design elements elicits, some of the clues a designer should exploit to ensure that "values and behavior indoctrinated through cultural influences may be reflected in design practices" [7].

Criticisms on the rigidity and obsoleteness of some designs has been directed to the hallowed positions of cultural models proposed by Hall [2] and Hofstede[4]. This is largely because globalization and culture are verily fluid, amorphous and always in transition[5]; and not defined by geographical borders existing between countries. Despite these criticisms, qualitative studies on websites designs still border on the propositions of Hall and Hofstede. Hall proposed some variable that aids the situating of cultures along a dimension spanning from high-content/low-content to the low-context/high-content. These variables include Nonverbal communication, Directness vs Indirectness, Time perception (monochronic vs polychronic) and Message speed. On the other hand Hofstede also proposed variables for culture which include Collectivism versus Individualism dimension.

II. Related Empirical Studies

Using Hall's dimensions, Wurtz [7] performed a cross-cultural qualitative analysis in order to explore and explain the differences between website samples of both High Context (HC) and Low Context (LC) cultures. To aid his analysis, different countries were first classified as either HC or LC. Specifically, Japan, China, and Korea were classified under HC while Germany, Denmark, Sweden, Norway, Finland, and the United States were classified as LC. The design parameters with which the analyses were conducted include visual communication and navigation. In the study, while visual communication was based on the analytical model of Thorlacius [6] and dealt with the featured product on the site using layout, images, photographs, and animation. The navigation dealt with the features of the website being considered.

Taking a different perspective from e-governance websites, Gygi and Spyridakis [1] developed a cultural model based on extant demographic data and values in order to analyze a school's website in Uzbek with the assumption that "Web sites designed by local producers for local users

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would embody and exhibit identifiable cultural markers". More so they evaluated the effect of language (Russian/English) in the Uzbek school website.

Yeratziotis and Greunen [8], employed Hall's cultural model of cultural context to determine the culture context profile of the South Africa (SA) government website and it ascertained whether it followed the standard e-government guidelines of the UK government for its design and implementation. Using a table they presented an assessment of the SA government's website on a three point scale compliancy level. However, they discovered that the SA government website did not follow the U.K. guidelines for government website development. Therefore, the website just provided a basic level of satisfaction for service delivery.

In order to aid governments in ensuring that their websites cater for actual needs of local users, Herselman and Greunen [3], performed a global survey on culture differences and contexts. They argued that their contribution will add to the websites effectiveness and usability. The study focused its questionnaire on selected populations; therein ten participants were identified through purposive sampling and divided into two groups (5) in low-context culture and (5) in high-context culture. Results of the study were contrary to literature and have it that high-context participants preferred more low-context styles when using government websites.

It is noteworthy that the analyses on the contexts of culture in websites in Yeratziotis and Greunen [8] and Herselman and Greunen [3] were done using parameters gleaned from Table 1 and Table 2 below. While, Table 1 present the observations of the characteristics of high and low cultures websites, Table 2 present the other perspectives for values and features that are necessary when designing software products for high and low-context societies.

Table 1: Observations for High/Low Contexts in Web Design [7]

Parameter	HC Cultures	LC Cultures
Animation	High use of animation, especially in connection with images of moving people.	Lower use of animation, mainly reserved for highlighting effects (e.g., of text, active links, logos)
Promotion of Values	Images promote values Characteristic of collectivist societies (e.g., being in good physical shape, spending time with family and friends)	Images promote values characteristic of individualistic societies (e.g. individuals are portrayed being in a more relaxed situations, such as holiday or listening to music – value personal time)
Individuals separate or together with the product	Featured images depict products and merchandise in use by individuals	Images portray lifestyles of individuals, with or without a direct emphasis on the use of products or merchandise
Level of transparency	Links promote an exploratory approach to navigation on the website; process-oriented	Clear and redundant cues in connection with navigation on a website; goal-oriented
Linear vs. parallel navigation on the Web site	More of a montage/layer-upon-layer approach. Many sidebars and menus, opening of new browser windows for each new page	Few sidebars and menus, constant opening in same browser window

Table 2: High- and Low-context features [3]

High-context features	Low-context features
Polychronic aspects of time	Monochronic aspects of time
Multiple use of images and/or banners	Less use of images and/or banners
Multiple use of links (external links promote a collectivist nature, working together)	Less use of links
Use of Flash features	Little use of Flash features
Being polite and indirect	Being direct and even confrontational
Create a friendly relationship with the customer (soft-sell approach)	Sales orientation (hard-sell approach)
Use of aesthetics to elicit emotion (harmony, beauty, nature, art, designs)	Direct communication (focus on rank and prestige, superlatives, terms and conditions)

III. Methodology

To generate requisite information for the study, three major sources were explored. Firstly, a literature review was carried out on the fields of culture, culture-context dimensions, e-government and government websites design. Apart from analyzing these concepts individually, analyses of one concept in relation to the other were also done. The aim of the analysis was to generate an online questionnaire survey to enable the evaluation of the e-government websites in Nigeria. A sample size drawn from the six geopolitical regions of Nigeria contributed to the survey findings. The questionnaire was designed to mirror the parameters shown in Table 1 and Table 2 respectively. The selected websites for the survey are presented in Table 3.

Table 3: Nigerian Institutions and their Web Links

Institutions	Web links
Corporate Affairs Commission	http://new.cac.gov.ng
Federal Inland Revenue Service	http://www.firs.gov.ng
National Agency for Food and Drug Administration Control	http://www.nafdac.gov.ng/
National Pension Commission	http://www.pencom.gov.ng/
Nigeria Export Promotion Council	http://www.nepc.gov.ng/
Nigeria Tourism Development Corporation	https://cdnetng.org/
National Emergency Management Agency	http://nema.gov.ng/

IV. Results Yielded by the Study

The considered some of the basic factors listed in tables 1 and 2. The design parameters gleaned from the tables included animation, promotion of values, individuals separate or together with the product, level of transparency, linear vs parallel navigation on the web site, multiple use of links, creating friendly relationship with the website visitor, use of aesthetics, color and use of search engines.

A four point method was employed to analyze the above-listed heuristics. These include;

a. YES: when one concurs with a statement
b. NO: when one disagrees with a statement
c. UNDECIDED: when one cannot seem to make up his/her mind on an accurate answer to a statement
d. NOT APPLICABLE (N/A): when one feels that the statement does not apply to the web site.

The questionnaire also included a section for open ended answers with respect to Table 1 and Table 2. Therefore, we solicited for the rationale for response to the questions using any of the four points listed above. In addition, the respondents were instructed to judge the use of more than one image/banner as high and to judge the use of more than three colors as high. The implication of this is that, one image alone is judged as low while the use of less than three colors is judged as low. Eventually, the entire questionnaires were collated and analyzed according to whether a particular design parameter is either high or low-context.

a) Corporate Affairs Commission (CAC)

This commission/agency is an independent body whose function is to regulate the creation as well as the management of companies in Nigeria. Specifically, their functions include registration of new companies, registration of business names and the registration of incorporated trustees. They are able to achieve all these through accredited members of some associations within the country. The commission's website is depicted in Figure 1 while the analyses of its culture context profile are presented in Table 4.

Figure 1: Welcome page for Corporate Affairs Commission

Table 4: Summary of Cultural-Context Results for CAC

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	High
2.	Promotion of values	Low
3.	Individuals separate or together with the product	Low
4.	Level of transparency	Low
5.	Linear vs parallel navigation on the web site	High/Low
6.	Multiple use of links	High
7.	Sell approach	High
8.	Use of aesthetics	Low
9.	Color	Low
10.	Searching	High
11.	Polite/Direct	Low

b) Federal Inland Revenue Service (FIRS)

The FIRS is a government institution that is charged with collating and collection of federal government taxes across Nigeria. Their other functions include ensuring tax payment compliance by companies, enterprises and individuals, giving taxpayers the moral and legal right to demand for the culture of accountability and providing sustainable finance and funding for governance, public and social services and economic development. The commission's website is depicted in Figure 2 while the analyses of its culture context profile are presented in Table 5.

Figure 2: Welcome page for Federal Inland Revenue Service

Table 5: Summary of Cultural-Context Results for FIRS

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	High
2.	Promotion of values	Low
3.	Individuals separate or together with the product	N/A
4.	Level of transparency	Low
5.	Linear vs parallel navigation on the web site	High/Low
6.	Multiple use of links	High
7.	Sell approach	Low
8.	Use of aesthetics	Low
9.	Color	High
10.	Searching	High
11.	Polite/Direct	Low

c) National Agency for Food and Drug Administration Control (NAFDAC)

NAFDAC is another federal government agency in Nigeria whose responsibilities include the regulation and control of the manufacture, importation, exportation, advertisement, distribution, sale and use of every type of food, drugs, cosmetics, medical devices, chemicals and packaged water. The organization also performs tests, inspection of the items mentioned above and ensures that there is a total compliance with stipulated and acceptable standards and quality. The agency's website is depicted in Figure 3 while the analyses of its culture context profile are presented in Table 6.

Figure 3: Welcome page for National Agency for Food and Drug Administration Control

Table 6: Summary of Cultural-Context Results for NAFDAC

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	High
2.	Promotion of values	High
3.	Individuals separate or together with the product	N/A
4.	Level of transparency	Low
5.	Linear vs parallel navigation on the web site	High
6.	Multiple use of links	High
7.	Sell approach	Low
8.	Use of aesthetics	Low
9.	Color	High
10.	Searching	High
11.	Polite/Direct	High

d) National Pension Commission (NPC)

The National Pension Commission fondly called PenCom, is the Nigerian federal government commission charged with the supervision and regulation of the contributory pension scheme (CPS) and the old defined benefits (DB) scheme as well as the pension translational arrangement directorate (PTAD). In summary, the organization's duty is to ensure that retirement benefits are paid to retirees as and when due. The commission's website is depicted in Figure 4 while the analyses of its culture context profile are presented in Table 7.

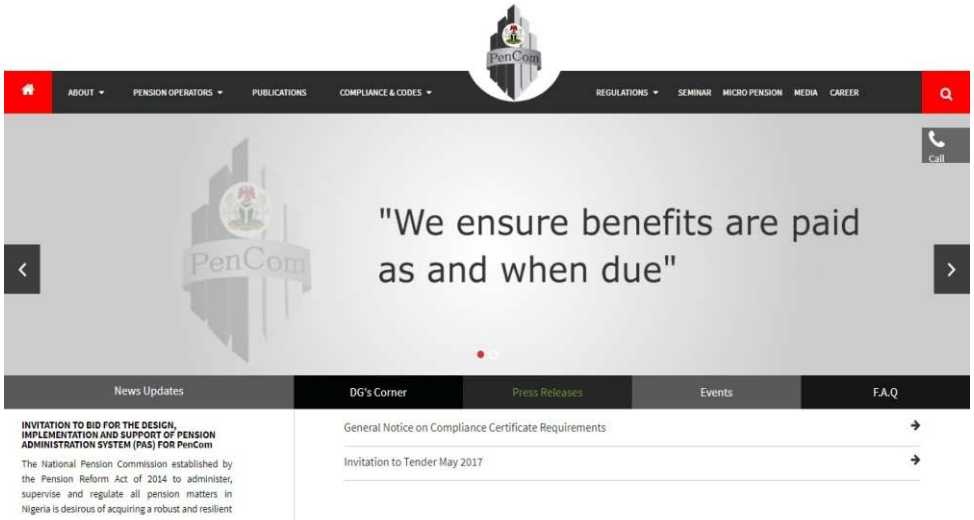

Figure 4: Welcome page for National Pension Commission

Table 7: Summary of Cultural-Context Results for NPC

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	High
2.	Promotion of values	High
3.	Individuals separate or together with the product	Low
4.	Level of transparency	High/Low
5.	Linear vs parallel navigation on the web site	High
6.	Multiple use of links	High
7.	Sell approach	Low
8.	Use of aesthetics	Low
9.	Color	High
10.	Searching	High
11.	Polite/Direct	High

e) Nigeria Export Promotion Council (NEPC)

This Council in Nigeria, is the leading Federal Government agency charged with the responsibility of promoting non-oil export in Nigeria to diversify away from oil and build a formidable economy. The agency is also saddled with the responsibility of promoting development of export trade, maintaining adequate representation in other countries and to administer grants and benefits related to export promotion and development. The council's website is depicted in Figure 5 while the analyses of its culture context profile are presented in Table 8.

Figure 5: Welcome page for Nigeria Export Promotion Commission

Table 8: Summary of Cultural-Context Results for NEPC

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	High
2.	Promotion of values	High
3.	Individuals separate or together with the product	Low
4.	Level of transparency	High
5.	Linear vs parallel navigation on the web site	High
6.	Multiple use of links	High
7.	Sell approach	Low
8.	Use of aesthetics	Low
9.	Color	High
10.	Searching	High
11.	Polite/Direct	Low

f) Nigerian Tourism Development Corporation (NTDC)

NTDC is the Nigerian agency to the federal government which is responsible for the overall development of the country's tourism. The agency promotes the country as a domestic and international tourist destination for leisure, business, religion, festivals and commerce. The commission's website is depicted in Figure 6 while the analyses of its culture context profile are presented in Table 9.

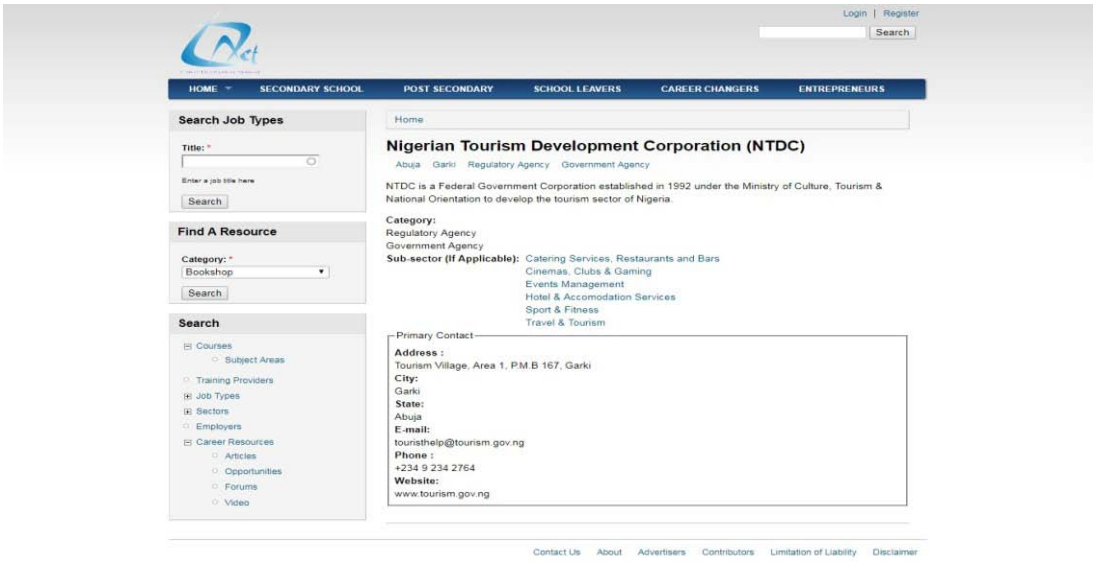

Figure 6: Welcome page for Nigerian Tourism Development Corporation

Table 9: Summary of Cultural-Context Results for NTDC

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	Low
2.	Promotion of values	Low
3.	Individuals separate or together with the product	Low
4.	Level of transparency	High
5.	Linear vs parallel navigation on the web site	High/Low
6.	Multiple use of links	High
7.	Sell approach	N/A
8.	Use of aesthetics	Low
9.	Color	Low
10.	Searching	High
11.	Polite/Direct	N/A

g) National Emergency Management Agency (NEMA)

The National Emergency Management Agency (NEMA) is a federal government agency in Nigeria, created with the sole purpose of managing all types of disasters. Their functions include the coordination of resources towards efficient and effective disaster prevention, preparation, mitigation and response in Nigeria. The agency's website is depicted in Figure 7 while the analyses of its culture context profile are presented in Table 10.

Figure 7: Welcome page for National Emergency Management Agency

Table 10: Summary of Cultural-Context Results for NEMA

S/N	Design Parameter	Culture Context Status
1.	Animation (Multiple use of images/banners)	High
2.	Promotion of values	High
3.	Individuals separate or together with the product	Low
4.	Level of transparency	High/Low
5.	Linear vs parallel navigation on the web site	High
6.	Multiple use of links	High
7.	Sell approach	High
8.	Use of aesthetics	High
9.	Color	High
10.	Searching	High
11.	Polite/Direct	High

V. Conclusion

This study employed the online survey method in order to determine the culture context profile of some prominent Nigerian institution's websites. The questionnaires were distributed to a group of experts in the field of website design and their responses were collated and analyzed and presented in Table 11. According to the answers derived from the respondents' to the questionnaire based on the reasons for the choice of their answers, the following conclusions were derived; That the following four agencies which include; CAC, NAFDAC, NEPC, NEMA out the seven websites understudied, used green and white for their design. These are the colors that make up the Nigerian flag. Also, the websites involved the use of lots of images and banners. As an example, the NEMA homepage in two separate sections has 9 banners and 5 images. The banners and images alternatively appear on the homepage. There were also cases where respondents answered both YES and NO to questionnaire items with respect to the design parameters and gave their reasons for doing so. The implication of these is that such websites exhibited both high and low context tendencies in that design parameter. Table 11 shows that Nigerian web designs are predominantly high context culture because 42 out of 77 expected statuses favored high context.

Table 11: Grand Summary of Cultural-Context Results

Institution	High	Low	High/Low	N/A	
CAC	4	6	1	-	
FIRS	4	5	1	1	
NAFDAC	7	3	-	1	
NPC	7	3	1	-	
NEPC	8	3	-	-	
NTDC	3	5	1	2	
NEMA	9	1	1	-	
Total	42	26	5	4	= 77

Table 12: Grand Summary for Design Parameters

S/N.	Design Parameter	High	Low	High/Low	N/A	
1.	Animation (Multiple use of images/banners)	6	1	-	-	
2.	Promotion of values	4	3	-	-	
3.	Individuals separate or together with the product	-	5	-	2	
4.	Level of transparency	2	3	2	-	
5.	Linear vs parallel navigation on the web site	4	-	3	-	
6.	Multiple use of links	7	-	-	-	
7.	Sell approach	2	4	-	1	
8.	Use of aesthetics	2	5	-	-	
9.	Color	5	2	-	-	
10.	Searching	7	-	-	-	
11.	Polite/Direct	3	3	-	1	
	Total	42	26	5	4	= 77

Table 12 depicts the profile of institutions' website in Nigeria in terms of actual design parameter. Apart from parameters 3 in the table 12, individual/separate and together with product, 7 (sell approach) and 8 (use of aesthetics), other parameters was high-context style. The implication is that, Nigerian agencies' website designers follow high context style in terms of animation, promotion of values, level of transparency, navigation, multiple use of links, color, search and polite/direct approach. But for aesthetics, the responses for high were for harmony and beauty which is evident in some of the websites and not for art, designs and nature. Furthermore, we would perform a more holistic study to determine the culture-context profiles of other websites in Nigeria. This is verily necessary if we are to posit Nigeria (and Africa) in Hall's culture continuum.

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A New Ranking Algorithm for a Round-Robin Tournament

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Abstract- The problem of ranking players in a round-robin tournament, in which outcome of any match is a win or a loss, is to rank players according to their performances in the tournament. In this paper, we have improved previously developed MST (Majority Spanning Tree) algorithm for solving this problem, where the number of violations has been chosen as the criterion of optimality. We have compared the performance of our algorithm with the MST algorithm and GIK algorithm.

Keywords: ranking, round-robin tournament, upset, digraph, MST, GIK.

GJCST-G Classification: I.1.2, G.1.2

A New Ranking Algorithm for a Round-Robin Tournament

Raghad Rowaida [α] & Afsana Ahmed Munia [σ]

Abstract- The problem of ranking players in a round-robin tournament, in which outcome of any match is a win or a loss, is to rank players according to their performances in the tournament. In this paper, we have improved previously developed MST (Majority Spanning Tree) algorithm for solving this problem, where the number of violations has been chosen as the criterion of optimality. We have compared the performance of our algorithm with the MST algorithm and GIK algorithm.

Keywords: ranking, round-robin tournament, upset, digraph, MST, GIK.

I. Introduction

The problem of ranking players in a tournament has been the subject of various research investigations. This tournament structure also arises in other environments like the problems of soliciting customer preferences of a set of products, establishing funding priorities of a set of projects [5], establishing searching priorities for a set of search engines in the internet. It is known that the results of a tournament can be represented in adigraph, G=(V, A) known as tournament graph, where vertices correspond to players and arcs correspond to match results. A tournament result is said to be upset (or violation) if a lowly-ranked player has defeated a highly-ranked player. Ali[1], Cook[6], Goddard[5], Poljak[3] and many others have concentrated on the problem of determining ranks based on the results of the tournament. A constructive lower bound on the tournament ranking function was obtained in [4]. In [2], a heuristic solution to optimize the number of violations has been developed. This paper presents a new version of MST algorithm which reduces the number of violations compared to MST algorithm. The problem of minimizing the number of upsets is equivalent to finding the minimum number of arcs in adigraph deletion of which results in an acyclic digraph.

This problem is knownas Minimum Feedback Arc set Problem, and is NP-hard for general digraphs [1].

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II. Preliminaries

Before describing the new algorithm, we present here a brief discussion on MST algorithm [2] and GIK algorithm [1].

MST: For ease of discussion we recapitulate some of the definitions used in MST algorithm.

1. *cutset(i, k, j)* – *is* the difference between the numbers of outgoing arcs from set (i, k) to set (k + 1, j) and outgoing arcs from set (k + 1, j) to set (i, j), where set (i, j) is the set of vertices corresponding to players ranked from i to j.
2. *maxwin(i, j)* – is the maximum number of wins of a player in set (i, j).
3. *pair(i, j)* – corresponds to an upset if the player ranked j defeats the player ranked i.
4. *size* – is the number of players in the tournament.

```
MST ()
    Repeat until swap = false
    swap ←false
    for i= 1 to size-1 do
        for j = i + 1 to size do
            for k=i to j-1 do
                if cutset(i,k,j)< 0
                    swap ←true
                elseif cutset(i,k,j)= 0
                    if pair(i,j) or ( i
                    - l , k + l) or
                    (k,j+ l) is
                    upset then
                        swap ← true
                        swap
                        respective
                        pair
                    else if maxwin(i,
                    k) < maxwm(k + 1,
                    j)
                        swap
                        respective
                        pair
                    endif
                endif
            if swap = true then
                swap set ({i, k),
                {k+ 1,j})
```

```
                endif
            endfor (k-loop)
        endfor (j-loop)
    endfor (i-loop)
```

Assuming the number of players in the tournament to be n, complexity of the MST algorithm can be derived as follows: In the k-loop, calculation of cutset value requires *O(n)* operations. Each of the i, j and k-loop will be done at most n times for a single swap, which will reduce the number of violations by 1. The amount of computation for this is at most $O(n^4)$. Since there can be at most $O(n^2)$ violations initially, the algorithm requires at most $O(n^6)$ calculations.

GIK: This algorithm is based on the IK algorithm [ ]. When applying the IK algorithm to rank a tournament, two basic steps are executed in case of a tie. The first attempts to break the tie by restoring the players, while the second (which is applied when the first step fails) randomly ranks the players involved in the tie. The GIK algorithm differs from the IK procedure in these two steps. The restoring method is different, and if this restoring method does not resolve the ties, an attempt is made to rank the players in a manner that will reduce the overall number of violations.

The GIK algorithm appears below. The following conventions are used.

a. $|S|$ denotes the cardinality of the set of players.
b. $\varnothing$ denotes the empty set.
c. If S_1, and S_2 denote sets (subsets) of players, then $S_1 \backslash S_2$, denotes those players in S_1, but not in S_2.
d. If R denotes a ranking and *P* a player, $R||P$ denotes the ranking formed by placing player *P* after the last player in the ranking *R.*
e. Given $R_1 = (P_1 > P_2 > \ldots > P_k)$ and $R, = (Q_1 > Q_2 > \ldots > Q_J$, then $R1||R2 , = (P_1 > P_2 > \ldots > P_k > Q_1 > Q_2 > \ldots > Q_J)$.

The GIK Algorithm

1. Let $R = \varnothing$, $A = \{P_1, P_2, \ldots, P_n\}$.
2. If $A = \varnothing$, then to go (15); otherwise determine the current scores of players in A.
3. If $A = \varnothing$, then go to (15); otherwise determine *D,* the dominant set.
4. If $|D| > 1$, then to go (6).
5. Letting *P* denote the only player in *D,* form the ranking $R = R || P$, let $A = A\backslash\{P\}$ and go to (3).
6. If from the last time of updating the current scores of A [step (2)], set A has changed, then go to(2).
7. If $|D| > 2$, then go to (9).
8. Let P_1 and P_2, denote the players in D with $P_1 > P_2$. Let $R = R|| P_1 ||P_2$, and $A=A\backslash\{P_1, P_2\}$. *Go* to (2).
9. If $R = \varnothing$, then go to (11).
10. Arrange all players in *D* in Hamiltonian order H, i.e. $H = (P_1 > P_2 > \ldots > P_k)$. Let $R = R || H$ and $A = A\backslash\{P_1, P_2, \ldots, P_k\}$.*Go* to (2).
11. Let Q denote the last player presently in *R,* and let $\{P_1, P_2, \ldots, P_k\}$ constitute *D.* Let i = 1.
12. If $i > k$, *go* to (10).
13. If $Pi > Q$, put *Pi* in *R* ahead of Q. Let $A = A\backslash\{Pi\}$ and $D = D\backslash\{Pi\}$. If $|D| = \varnothing$, then go to (2).Otherwise go to (4).
14. Let $i = i + 1$, and go to (12).
15. Execute procedure Arrange on the ranking *R.*
16. End.

III. The New Algorithm

In this Section we propose A new version of MST algorithm that results in minimum number of upset compared to the MST algorithm and GIK algorithm for ranking players in a round-robin tournament [].

We consider only simple connected digraphs G=(V,A). Spanning trees of any digraph are denoted by T. A directed cutset(V_i,V_j) is defined as $(V_i,V_j)=\{(k,l)|k \in V_i, l \in V_j\}$

For improvement of the algorithm we introduce the following symbols and functions:

Sa — start of setA
Ea —end of setA
Sb — start of setB
Eb —end of setB
Sc — start of setC
Ec —end of setC

Cutset(A,B)- is the difference between the numbers of outgoing arcs from set A to set B and outgoing arcs from set B to set A.

Cutset(A,C)- is the difference between the numbers of outgoing arcs from set A to set C and outgoing arcs from set B to set A.

Cutset(B,C)- is the difference between the numbers of outgoing arcs from set B to set C and outgoing arcs from set C to set B.

Procedure: Improved MST

```
Repeat until swap = true
swap = false
  for Sa =0 to size – 1 do
    for Ea = Sa to size-1 do
      for Sb = Ea to size – 1 do
        for Eb =Sb to size – 1 do
          for Sc = Eb+1 to size do
            for Ec = Sc to size do
              if  (cutset(A,B)  +
             cutset(A,C)        +
             cutset(B,C)) < 0) then
                 swap = true
              else  if(cutset(A,B)
            +    cutset(A,C)    +
```

```
cutset(B,C)) = 0) then
    if(pair(Sa-
  1,Sa)or
  pair(Ea,Sb)orpair(E
  b,Sc)orpair(Ec,Ec+1
  ) is upset )then
      swap = true
      swap respective
    pair
   else            if
  (maxwin(Sa,Ea)<maxw
  in(Sc,Ec))
      swap=true
      swap respective
    pair
   if    (swap==true)
  then
      swapSet(A,C)
 break Ec-loop
break Sc-loop
break Eb-loop
break Sb-loop
break Ea-loop
break Sa-loop
```

IV. Experimental Results

The new_MST Algorithm has been compared with MST Algorithm and the GIK algorithm on the basis of a set of randomly generated tournaments of sizes ranging from 5 to 50 players. All algorithms have been programmed in C and runs were made on a core i3 machines. We have been measured both in terms of violations and computational time. Here new_MST gives better result compared to MST and GIK with respect to number of violations.

Table 1: Comparison among new MST, MST and GIK in terms of number of violations

No of player	Initial upset	GIK	MST	New MST
5	3.66	2.66	1.66	1.66
10	24.00	13.33	9.00	8.66
15	47.33	39.33	25.66	24.66
20	89.00	38.33	25.33	22.00
25	194.33	109.66	76.33	72.33
30	106.66	94.66	67.33	61.00
40	482.00	138.66	88.66	79.00
50	585.66	515.00	439.00	418.33

Table 2: Average computational time of three algorithms in seconds

No of player	GIK	MST	New MST
5	0.0013	0.0030	0.0010
10	0.0103	0.0090	0.0110
15	0.0173	0.0093	0.0680
20	0.0226	0.0236	0.5756
25	0.0266	0.0563	88.5506
30	0.0320	0.0216	1268.37
40	0.043	0.1913	24877.110
50	0.054	4.147	63415.8188

V. Conclusion

Experimental results show that our new MST algorithm reduces the number of violations compared to GIK and MST algorithm but the drawback is new MST algorithm requires huge time compared to those algorithms.

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Quantum Computing Tutorial Bits vs Qubits and Shor's Algorithm

By Koffka Khan
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Abstract- The speculative inquiry that computation could be done in general more efficiently by utilizing quantum effects was introduced by Richard Feynman. Peter Shor described a polynomial time quantum algorithm for factoring integers by a quantum machine, which proved the speculation true. Quantum systems utilize exponential parallelism, which cannot be done by classical computers. However, quantum decoherence poses a difficulty for measuring quantum states in modern quantum computers. This paper elaborates on some basic concepts applied to quantum computing. It first outlines these key concepts, introduces the mathematics needed for understanding quantum computing and finally explores the Shor's Algorithm as it applies to both classical and quantum computer security.

Keywords: *quantum; computing; shor's; algorithm; security.*

GJCST-G Classification: *I.1.2, F.2.2*

Strictly as per the compliance and regulations of:

Quantum Computing Tutorial Bits vs Qubits and Shor's Algorithm

Koffka Khan

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I. Introduction

In 2017, IBM has a 16-qubit Quantum computer on the cloud available for users worldwide. These and other revolutionary breakthroughs over the past years have propelled the world of quantum computing into the spotlight.

First let us see, how classical computers work. A classical computer works with the binary numbering system, and the computer is not able to compute with the decimal numbering system. Binary system has only two digits. All arithmetic operations are done by the binary system based logic. Let us use an example of adding two single digit binary numbers using yes or no logic. Turn the first bit on, if any one of the bit is on, that is exclusive OR. Turn the second bit on if both the bits are on, that is AND. We can use electrical-switches as an input device and lights as output device. Transistors can be used for binary-logic based operations and turning on or off the lights based on the switch settings. Transistors can be inter-connected in particular way to pass the electric-current by with switches. A mobile phone has millions of transistors inside. A computer has billions of transistors inside. Computer likes binary states.

How about the quantum state, which has the states of both 0 and 1 at the same time? Binary bit state may be 0 or 1. Quantum qubit state will be both 0 and 1 at the same time. As individual digits of input numbers have all possible ways, the result will also have all possible values. Two single digit qubit numbers addition will make 4 possible combinations. Two double-digit Qubit numbers addition will make 16 possible combinations and so on. All types of arithmetic operations do this kind of computation. Therefore, a quantum computer computes all possible ways in parallel. But classical computer computes only one at a time. Take the maze as an example. The maze has an entrance and the maze is inside. The entrance is split into multiple paths and has only one exit. The task of computer is to find the correct path which leads to the exit. Classical computer has to travel each path to find the exit. However, a quantum computer can travel all paths simultaneously and find the exit immediately. It computes all possible combinations simultaneously and choosing the best one.

Classical computer uses transistors to create binary-based Logic-Gates. Subatomic particles such as electrons and photons behave in a very strange way. Electron has a property of spin. The spin state may be Up, Down, Right or left. The spin state will be both Up and Down or Right and Left simultaneously in particular scenario. Such a state is called superposition [3] state. Photon has a property of polarization. The polarization state may be horizontal, or vertical. The polarization state will be both horizontal and vertical simultaneously in particular scenario. Light has strange behavior in the double-slit experiment. Light without any slit shows normal pattern. Light passing through single slit is spread out, because of quantum uncertainty behavior. Light passing through double slit shows interference pattern because of the wave behavior of light. Passing single photon at a time in single slit hits random place, accumulates and shows the same spread pattern over the period. Passing single photon at a time in double slit hits random place, accumulates and shows the same interference pattern over the period. How can a single photon which is not a wave, show interference pattern? Actually, it splits in to two photons, passing through slits simultaneously, interferes with itself and shows interference pattern. The photon is in superposition state of passing both slits. The spread-pattern of single slit is also the superposition state of a photon is in all position simultaneously. The photon resides in this area with the possibility of all combinations. This superposition state can be used to create qubits, which is used in quantum computers. Superposition of particle spin can be used to create quantum logic gates. The superposition is collapsed and turned in to definite state when it gets measured.

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This paper consists of three sections. Section II discusses Quantum Concepts. Section III explores the Mathematics that support Quantum Computing, Section IV explains why cryptographic codes are so hard to break and finally Section V discusses Shor's Algorithm and Quantum Security.

II. Quantum Concepts

The fundamental unit of a classical computer is a bit. Bits have two states, 0 and 1. A classical computer takes in a string of bits and use logic gates to switch some of the bits. Quantum computers use quantum bits (qubits, [6]). Like a bit, a qubit can be in state 0 or state 1. Also like a classical computer, the initial program for a quantum computer is just a string of zeros and ones. However, while a quantum computer is running, its qubits can also be in infinitely many super positions [3] between 0 and 1. When a qubit is in a superposition, it has some probability of being in state 0 and some probability of being in state 1. You can think of a superposition as being a mixed state partway between 0 and 1. However, super positions are fragile. If we look at it or try to measure it, the qubit will collapse into a basic state, either 0 or 1. You might know this from the famous Schrodinger's cat thought experiment. Before opening the box, the mythic cat is in a superposition of alive and dead. However, when you observe the cat, it is forced to pick a state, alive or dead, not both. Qubit materials are usually things like electrons, where spin up corresponds to state 0 and spin down corresponds to state 1.

Let us see an example of a quantum computation with two qubits. There is four basic states, 0 0, 1 0, 0 1, and 1 1. The two classical bits can be in these states. However, there are also infinitely many states formed by superpositions or combinations of these basic states. Each operation of a quantum computation is performed by a quantum gate, which, like a classical gate, changes the state the qubits are in. Let us start our quantum computation in 0 0 and then apply a quantum gate. Now the qubits are in a superposition. There is a 1/2 probability or 50% chance of being 0 1 and a 1/2 probability of being 1 0. The particular superposition position it is in is a result of the quantum gate we chose to apply. Here is one more quantum gate, changing the state of our computation. At the end of the quantum computation, we observe or measure the system.

However, we cannot see these delicate superpositions. Remember, a superposition is like a mix between basic states. When you observe the computation and look at it from the perspective of these basic states, it must pick one, collapsing the wave function and revealing a single basic state. In this case, it collapsed to state 0 1. If you run the same computation repeatedly, the result will be 0 1 half the time, it will be 1 0 1/6 of the time, and 1 1 1/3 of the time. That is what the numbers in the superposition tell you. The probability that the superposition will collapse into each basic state. So if you run the computation 100 times, roughly 50 times it'll result in the state 0 1, 17 times it will result in state 1 0, and 33 times it will result in state 1 1. This allows you to recover the probabilities and therefore the final superposition of the computation. This does not seem very efficient with two qubits. Nevertheless, as we will see later, it can save you a lot of time with more qubits.

III. Mathematics that Support Quantum Computing

A vector can be a abstract concept in mathematics. Let us define a vector as a list of numbers and the dimension of that vector is the number of numbers in the list. Actual qubits use negative or even complex numbers, but let us deal with non-negative real numbers for now. One qubit is represented as a two-dimensional vector. The state 0, $|0\rangle$ and the state 1, $|1\rangle$. Moreover, this is a superposition, $a|0\rangle + b|1\rangle$. We can visualize the vector on a circle like this. The horizontal component is the square root of the probability of being in state 0. In addition, the vertical component is the square root of the probability of being in state 1. By the Pythagorean Theorem, the length of the vector is 1. Each point on the unit circle is a quantum state. A classical computer can only point up or right, but a quantum computer uses much more of the circle.

What about two qubits? It takes a four-dimensional vector to represent the four possible states. Here is the earlier computation in vector form.

The formula for the length of a two-dimensional vector easily generalizes to the formula for the length of a four-dimensional vector. Therefore, as we said before, all the quantum state vectors have length 1.

The two-dimensional vectors pointed to a spot on the unit circle in two-dimensional space. In addition, these four-dimensional vectors point to a spot on the unit sphere in four-dimensional space, which makes it very hard to visualize. If you have N qubits, there are two to the *N* basic states.

Therefore, a vector on a sphere represents the quantum state in two to the *N* dimensional space. Quantum gates change the system's state. Therefore, they move the state vector around the sphere. Mathematically, this is represented with a unitary matrix. For our purpose, a matrix, specifically a unitary matrix, is a block of numbers that describes how vectors move around the sphere. When we multiply it by the starting vector, 1 0 0 0, we get back a new vector, which represents our second state. Each quantum gate is a different unitary matrix, changing the vector, which represents the state of the qubits. We just apply this quantum gate to the state 0 0, represented by this vector, and got this state as a result. However, if we apply the same gate to state 1 0, represented by this vector, we get this state as a result. Note that the

superposition has negative numbers in it. To get the probability that the qubit collapses into each basic state, we just take the absolute value of the numbers. In fact, not only can these numbers be negative, they can actually be complex numbers. Notice that the state of *N* qubits is actually represented on a sphere in two to the *N* complex dimensions, which has twice the dimensionality of the sphere in two to the N real dimensions.

IV. Cryptography

Cracking open secure messages would be easy if only you knew how to factor huge numbers. One of the main methods of cryptography, the encoding and decoding secure communications, uses big prime numbers. It is easy for a computer to find big prime numbers and multiply them together, but it is hard for a computer to do the opposite-- find the prime factors of a big number. The prime factors of a number are all the prime numbers that evenly divide it. Normally, RSA (Rivest Shamir Adleman) [1] cryptography uses these prime factors like keys to decrypt messages. So if you want to eavesdrop, you'll need to find one of these keys to hack in--that is, you'll need to find the prime factors of a big number, and we're talking really big, as in hundreds of digits long. Let us try a small example. What are the prime factors of 35? Well, they are 5 and 7. How did you figure that out? Probably just by looking at it, but even if you had forgotten that fact, you could have just checked all the prime numbers smaller than 35. Does two divide it? No. Does 3? No. Does 5? Yes. And so on. This is for a computer, very time consuming. We will need to do something strategic to factor big numbers. Along with many, many other things Euler thought a lot about prime numbers, relatively prime numbers, and modular arithmetic, which is basically all the math underlying RSA cryptography. Therefore, it makes sense that we would use similar math to break the algorithm. Modular arithmetic is what happens when you count in a circle. Counting modulo 5, or mod 5 for short, goes 0, 1, 2, 3 4, 0, 1, 2, 3 4, 0, 1, 2, and so on. We just use the numbers less than 5 on repeat. We tell time mod 12 or mod 24 depending on your convention. This cyclical counting extends to the arithmetic operations. So 1 plus 2 mod 5 is still just 3, but 2 plus 3 mod 5 is 0, and 2 times 3 is 1 mod 5. Another way to think about modular arithmetic is in terms of the remainder when dividing numbers. Therefore, a slightly more formal definition follows. *a* is congruent to *x mod n* means that when we divide *a* by *n* the remainder is *x*. So 2 times 3 is 6, but when we divide 6 by 5, the remainder is 1. Therefore, 2 times 3 mod 5 is 1. Euler noticed something about modular arithmetic and exponentiation. Let us look at the powers of 3-- 3, 9, 27, 81, 243, and so on. In addition, let us look at them all mod 10.

It is easy to figure out what things are mod 10 because it is just the remainder when you divide by 10, which is the ones digit. So mod 10 our sequence is 3, 9, 7, 1, 3, 9, 7, 1, and so on. Let us repeat the same experiment, but instead of looking at the powers of 3 mod 10, let's look at the powers of 2 mod 7. The powers of 2 are 2, 4, 8, 16, 32, 64, and so on. In addition, mod 7 we get 2, 4, 1, 2, 4, 1, and so on. What do you observe? The sequence of powers just gets bigger and bigger, but the modular versions of the sequence cycle repeats. They repeat the same pattern over and over again, and the last digit of that pattern is always 1. As long as *x* and *n* are relatively prime, meaning they share no prime factors, the sequence *x mod N*, *x squared mod N*, *x cubed mod N*, *x to the fourth mod N*, and so on will always have this property. We call the length of the repeating pattern the period. Therefore, the period of 3 mod 10 is 4, and the period of 2 mod 7 is 3. Here is why the period is important. If the period of *x mod N* is some number *r*, then *r* is the smallest number such that *x* to the *r* is congruent to *1 mod n*. For example, 3 to the fourth is congruent to 1 mod 10, but 3 for the first, 3 squared, and 3 cubed are not 1 mod 10, but let's get back to our original goal. What does all this stuff about modular arithmetic, exponentiation, and periods have to do with factoring large numbers? Let us say I give you a number *n*. I tell you *n* equals *p times q* for two prime numbers *p* and *q*, but I do not tell you anything about those primes. Your job is to find them. Here is how you will do it.

Step one- pick any number smaller than n. Let us call the number you selected *a*. Check to make sure that *a* and *n* are relatively prime by computing the greatest common divisor of *a* and *n*. The greatest common divisor of two numbers is the biggest integer that divides them both, so it's 1 if the two numbers are relatively prime. The Euclidean algorithm is a quick and standard way to find the GCD [2] of two numbers. If they have a divisor in common, that is a factor of n, which is what you have been looking for, and you have saved yourself the rest of the steps.

Step two- compute the period of *a mod N*. Let us call it *r*. For the sake of example, let us say you are trying to find the factors of 35. Therefore, *n* equals 35, and you pick *a* equals 8 since its relatively prime to 35. Then with a little computation, we can see that *r* equals 4. To make all the arithmetic work out, we are going to need to divide *r* by 2. Therefore, we need to know that *r* is even. Later on, we will also need to know that *a* to the *r* over 2 plus 1 is not congruent to *0 mod N*. If either of these things fail, we need to pick a different *a* in step one. Luckily, there is at least a 50% chance you will pick a good value for a. So on average, you will not have to try too many times.

For step three, we will have to do some algebra. Let us start with the fact we know. *a* to the *r* is congruent to *1 mod N*, which, subtracting 1, gives the *a* to the *r minus 1* is congruent to *0 mod N*. Saying that something is *0 mod N* is the same as saying that it's a multiple of *N*. Therefore, there must exist some integer *k* such that *a* to

the *r minus 1* equals *k times N*. Since we assumed *r* is an even number, we can rewrite it as a to the *r* over *2 minus 1* times *a* to the *r* over 2 plus 1 equals *kN*. In addition, since *N* equals *pq*, we'll replace it with *pq*. Here is what happens with the example where we are trying to find the factors of 35. Since the period of 8 mod 35 is 4, we have 8 to the fourth is congruent to *1 mod 35*. Therefore, 8 to the fourth minus 1 is congruent to *0 mod 35*. Actually, 8 to the fourth minus 1 is 4,095, but we only care about its value mod 35. We could rewrite this as 8 to the fourth minus 1 equals *k* times 35 for some integer *k*. Again, we could solve for *k* in this case, but it is irrelevant, so I will leave it as a variable. Rewrite this as 8 squared minus 1 times 8 squared plus 1 equals *k* times *p* times *q* where *p* and *q* are the prime factors of 35 that we're searching for.

Step four-I claim that the greatest common divisor of *a* to the *r* over 2 minus 1 and *N* is one of the prime factors. Let us call it *p*, and the greatest common divisor of *a* to the *r* over 2 plus 1 and *N* is the other prime factor. Let us call it *q*. Why? The equation a to the *r* over 2 minus 1 times *a* to the *r* over 2 plus 1 equals *kpq* means that *p* must divide one of the factors on the left and *q* must divide one of the factors on the left, but they cannot divide the same factor since that factor would be divisible by *N*. Why is neither factor divisible by *N*? For one, we assumed a to the *r* over 2 plus 1 is not congruent to 0 mod *N*. For the other, we know *r* is the minimum value of *x* such that *a* to the *x* is congruent to *1 mod N*. So *a* to the *r* over 2 minus 1 is not congruent to *0 mod N*. Since *p* and *q* divide separate factors on the left side of the equation, we can assume *p* divides *a* to the *r* of 2 minus 1 and *q* divides *a* to the *r* over 2 plus 1. Therefore, our formulas work.

Therefore, in our example, *p* is the greatest common divisor of 63 and 35, which is 7. Moreover, *q* is the greatest common divisor of 65 and 35, which is 5, and is correct. In summary, here is the steps.

- Step one- pick a less than *N*.
- Step two- find the period of *a mod N*.
- Step three- check that *r* is even and *a* to the *r* over 2 plus 1 is not congruent to *0 mod N*. If either of these things fail, we need to go back to step one and pick a new value of a.
- Finally, step four-- let *p* equal the GCD of *a* to the *r* over 2 minus 1 and *N*. In addition, let *q* equal the GCD of *a* to the *r* over 2 plus 1 and *N*.

Step two, finding the period, takes a long time-- in fact, an exponentially long time. All the steps besides two are fast. Instead of looking for a needle in a haystack, we reduced the hard part to one step-- finding the period. In addition-- here is the big twist-- period finding is precisely the kind of thing a quantum computer is good at, and on the next section. The four steps we just reviewed are the outline of Shor's algorithm, and next section shows how to use a quantum computer to dramatically speed up step two.

V. Shor's Algorithm and Quantum Security

Remember, popular forms of cryptography work by multiplying together two large prime numbers and using those primes as keys to recover the message. Therefore, to crack the code, we will need to find the prime factors of a big number. However, that would take a classical computer a long time. Way longer than the encrypted information is probably useful for. However, Shor's algorithm [4] allows us to quickly factor large numbers using a quantum computer. Let us see how a classical computer would factor a prime number. What is the most straightforward way it could find the factors of a number *N*? Well, it could check. Is 2 a factor, is 3 factor, is 4 a factor, and so on. However, if *N* is big, this might take many steps. Now, if a quantum computer is just a bunch of classical computers working in parallel, then we could have one computer check if 2 is a factor, another check if 3 is a factor, and so on. Then it would only require two steps. We have split the many steps of a classical computer among the many parallel computations of a quantum computer. Here is the problem. When we say that a quantum computer is a bunch of classical computers working in parallel, what we really mean is that a quantum computer is in a superposition of basic states, which are the kind of states a classical computer could be in.

Remember, a superposition is a combination of basic states and there is some probability associated with observing each of them. To find that probability, you square the amplitude of the number in front of the basic state. Here, we have N basic states and a 1 over *N* probability of being in each state. Therefore, the quantum computer is not actually in all of these states. It is more like the quantum computer has split itself into N different pieces. However, when you measure a quantum computer, that is, ask for the result of a computation, it does not tell you about all *N* pieces it is in. Instead, it will pick a state, each with probability 1 over *N*, and tell you what that state says. You cannot look at the whole thing. Just one random state. That is a problem for us. Only two the *N* states give useful information. That the number of checked was a divisor of *N*. So the vast majority of the time we run the computation, *N* minus 2 over *N* of the time, the result will just tell you that something is not a factor of *N*. That means our algorithm is no more efficient than checking random numbers to see if they are divisors using a classical computer.

To harness the power of quantum computation, we need each of these basic states, the components of the superposition, to be working together. Right now, they are functioning as separate computers individually searching, which is a problem because the quantum computer cannot tell us about all these independent states. However, if there is some kind of underlying structure to the states, we can use that to amplify the states with the correct answers. In this case, the ones

that give the factors of a number. Then when we measure the quantum state, we will have a high probability of ending up with the correct answer. So instead of checking each number smaller than *N* to see if it is a factor, how does Shor's algorithm find the factors? It needs to utilize the properties of its entire superposition, and not just a few of its basic states. To do that, Shor's algorithm actually uses some number theory, to transform the problem of finding the factors of a given number into a problem of finding a different number, the period of a periodic function. Here is the four basic steps that outlines the number theory in Shor's algorithm for finding the two secret prime factors, *p* and *q*, of a given number *N*. That is, *N* is equal to *p* times *q*.

- Step 1, pick a number, *a* less than *n*, at random.
- Step 2, check to make sure it is not a factor of *N*. Step of *a mod N*.
- Step 3, check that *r* is even, and *a* to the *r* over 2 plus 1 is not congruent to *0 mod N*.
- Step 4, let *p* be the GCD of *a* to the *r* over 2 minus 1 and *N*, and *q* be the GCD of *a* to the *r* over 2 plus 1 and *N*. Then you found p and q, the two prime factors of *N*.

However, step 2 is the extremely long step. Remember, *N* is the number we are trying to find the factors of, and *a* is a selected number smaller than *N*. We are trying to find the smallest number *r*, which we call the period, such that a to the *r* is congruent to *1 mod N*. It is easy to find the period of a small example just by checking the powers of *a mod N* until we get 1. So if *N* is equal to 7 and a is equal to 2, we compute 2 to the 1 mod and 2 to the 3 mod 7 is 1. Therefore, the period is 3. However, if *N* is big, then *r*, the period, can be as big as *N*. There is no known efficient classical way to find the period. Remember how we tried to find the factors of *N* by letting the quantum computer act as *N* parallel classical computers, and using each to check a different factor? We could try the same thing to find the period. We begin with *N* different states representing the numbers for each state, we compute *a* to the *x mod N*, where *x* is the number of the state. So now the states are *a* to the 1 mod *N*, *a* to the 2 mod *N*, *a* to the 3 mod *N*, and so on. Then we just look for the smallest one that says 1, and we are done. That is when we run into the same problem as before. We cannot just scan all the states at once. When we look at the result of a quantum computation, it just shows one random state, which is not very helpful.

However, there is something different about this current problem. Something that will possibly help us. The period is a global property of this quantum superposition. It is not just a special fact about one or two of the basic states. It is a fact about this entire wave of numbers created by superposition, how often it repeats. That is the period. We can use this to our advantage. We apply something known as the quantum Fourier transform [5] to the superposition *a* to the 1 mod *N*, *a* to the 2 mod *N*, *a* to the 3 mod *N*, and so on. The quantum Fourier transform utilizes the ideas of quantum physics to do exactly what we want. It uses resonances to amplify the basic state associated with the correct period, and the incorrect answers destructively interfere, which suppress their amplitudes. After applying the quantum Fourier transform, there is a very high probability that we will pick the correct period. So how does it work?

To understand the quantum Fourier transform, we will need to start with a quick version of a branch of math known as complex analysis. What we will really be doing is adding complex roots of unity. However, if you are not familiar with that concept, do not worry. Start with a bunch of circles. On the first, we will put two equally spaced dots. On the next, we will put three equally spaced lines. On the next, four equally spaced dots. And so on. Notice, though, we always put one of the dots on the middle right side, the 0-degree angle. Start a dial on that special point. By the way, these dots are called complex roots of unity. Now, let us focus on the circle with three dots. We will move the dial counter-clockwise through the points. In addition, underneath the dial, we will form a path consisting of arrows where the direction of the arrow is given by the direction in which the dial points. For example, with three dots, the first arrow points east. Then move the dial one dot counterclockwise and connect to the first arrow another that points northwest, like the dial. Move the dial again and connect another arrow pointing southwest, the same direction as the dial. Notice that after three arrows, we are back where we started. This is what it looks like on a circle with six dots. Again, after six arrows, we are back to the starting place. Remember that we have a superposition whose basic states look like *a* to the 1 mod N, *a* to the 2 mod N, *a* to the 3 mod N, and so on. Let us pick a tiny example, like *a* equals 2 and N equals 7. Then the components of the superposition are 2 to the 1 mod 7, 2 to the 2 mod 7, 2 to the 3 mod 7, and so on, which is the repeating pattern 2 4 1, 2 4. Because this example is so small, we can just see that the period is three by looking at it. However, how can we use our dials to figure out period? We will move along the sequence *a* to the 1 mod N, *a* to the 2 mod N, *a* to the 3 mod N. For each term in the sequence, move every dial once counter-clockwise. Any time we encounter a 1, stop and record where the dial is pointing with an arrow. Let us focus on the sequence. The dial with three points is always pointing directly east when we record its values. Therefore, our path of arrows just runs off to the right. However, what happens to the dial with four points? The first time we encounter a 1, its facing south. The next time, it's facing west. The next time, it is facing north. In addition, the fourth time we encounter. Therefore, our path of arrows has looped back to where it started. In fact, this will happen with all of the numbers besides 3. They will all just make loops near the starting

point. The distance of the arrow from the starting point is like the amplitude, or probability of a state. Since we are most likely to observe these states at the end of the computation, we are set. We have magnified the correct answer. In addition, that is roughly how the quantum Fourier transform works.

Here is another way to think about it. Pretend you are on a swing with period three seconds. It swings back and forth every three seconds. The arrows from before are like the kicks on a swing that you time as you try to get higher and higher on the swing. If the kicks are timed off resonance with the swing's natural frequency, so anything other than every three seconds, then you end up slowing down the swing. However, if every kick is timed to match the frequency of the swing, every three seconds, you create resonance, amplifying the swing's motion. If we start with a bunch of states, metaphorically swings, with different periods, than only the swing with the correct period will be moving after a while. It will be the state with the biggest amplitude or highest probability of being observed. Of course, there is no actual dials or arrow paths or swings in a quantum computer. That is just a visual representation of adding complex numbers, which are the amplitudes of waves. Waves and their crazy ability to either reinforce each other with constructive interference, or negate each other with destructive interference, are at the heart of quantum physics. The dial with three dots is showing constructive interference by making the arrow path grow, which represents the likelihood the quantum computer will measure that state. The other dials are destructively interfering, making it less likely we will detect them.

VI. Conclusion

This paper elaborates on some basic concepts applied to quantum computing. It first outlines these key concepts, introduces the mathematics needed for understanding quantum computing and finally explores the Shor's Algorithm as it applies to both classical and quantum computer security.

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2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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- What you account in an conceptual must be regular with what you reported in the manuscript
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Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
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- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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